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NEW SOUTH WALES.

(DEPARTMENT OF MINES.)
✓ GEOLOGICAL SURVEY.

E. F. PITTMAN, A.R.S.M., Government Geologist

MINERAL RESOURCES
No. 13.

THE
FORBES-PARKES GOLD-FIELD.

BY

E. C. ANDREWS, B.A., F.G.S.,

GEOLOGICAL SURVEYOR.

1910.



SYDNEY: W. A. GULLICK, GOVERNMENT PRINTER.

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Department of Mines,

26 October, 1910.

Sir,

I have the honor to transmit for publication a report on the Forbes-Parkes Gold-field, by Mr. E. C. Andrews, B.A., Geological Surveyor.

The history of this gold-field is essentially one of variable fortune. In the year 1862 a large population was attracted to Forbes, owing to the discovery there of rich leads of alluvial gold. Four months after the beginning of the rush there were 28,000 persons encamped on the site of the present township, and during the first year's operations upwards of 235,000 oz. of gold were recovered. Owing, however, to the difficulty of following the leads into the deep ground, by reason of the large bodies of water met with, the population, as well as the yield of gold, rapidly decreased in the following year. Between 1862 and 1864 some valuable auriferous reefs were worked at Parkes, and in the year 1871 rich alluvial leads were discovered in that neighbourhood, and were subsequently worked with great success. After a long period of inaction, mining at Forbes was revived in 1896 by the opening of the celebrated Lachlan Mines, in which payable reefs were worked for some years; but although work is still carried on in the Forbes-Parkes Gold-field in a desultory kind of way, it must be admitted that the industry has been at a very low ebb since 1907.

It was with a view of stimulating prospecting on the old gold-field that Mr. Andrews was deputed to make a geological survey of the auriferous area, and place on record an historical account of the progress of mining there, and it is confidently hoped that his efforts will have the desired result.

I have the honor to be,

Sir,

Your obedient Servant,

EDWARD F. PITTMAN,

Government Geologist

The Honorable Alfred Edden, Esq., Minister for Mines.



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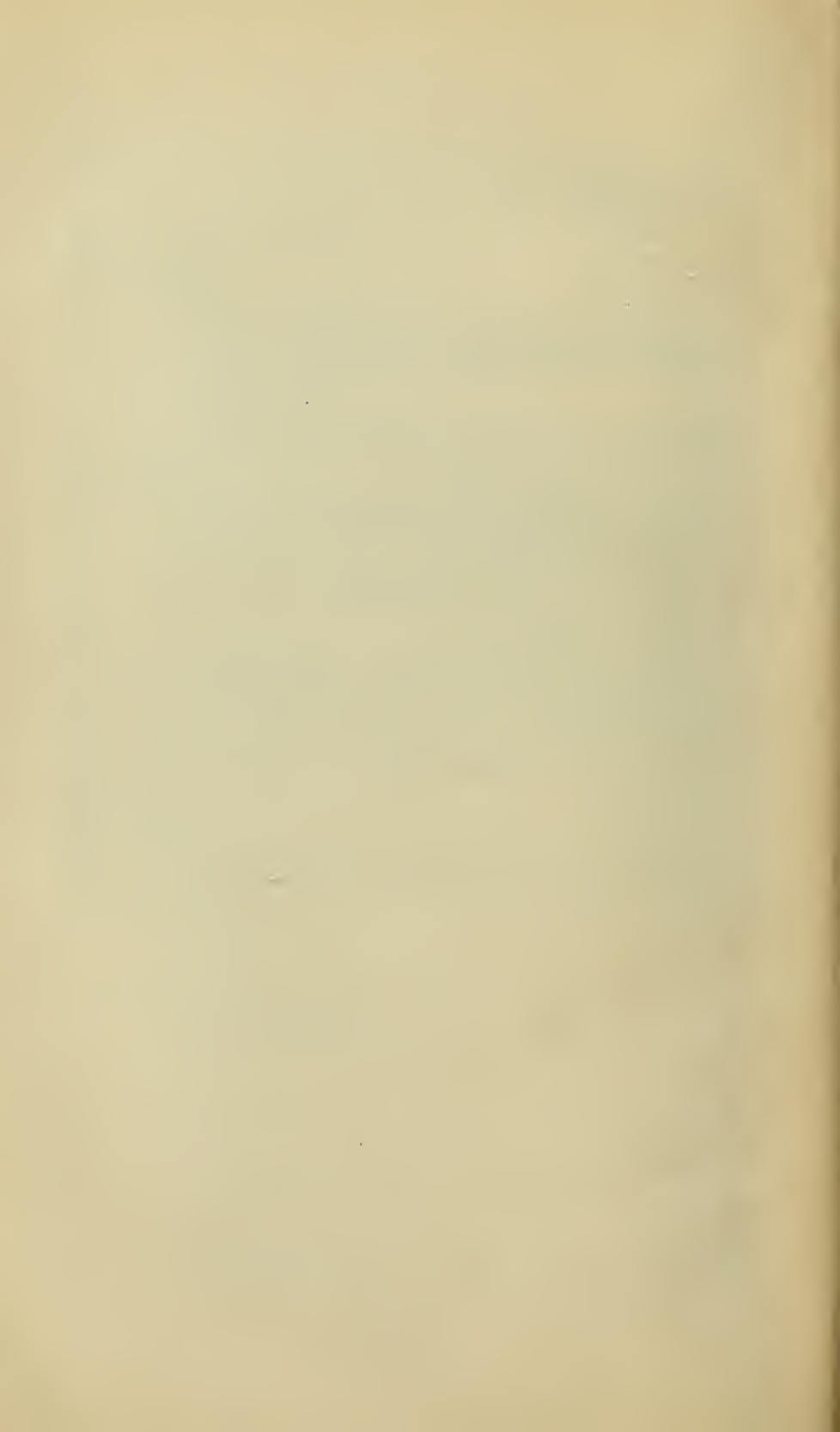
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II.—INTRODUCTION.

FORBES and Parkes have both been very important gold-fields, but the mining industry in these localities is now at a very low ebb. Almost every "lead" has been abandoned and every mine of importance is lying idle. As a result of this mining inactivity the whole workings are practically inaccessible to one conducting an ordinary geological survey at the present time. The chapters in this report devoted to the discussion on mining geology, and to the descriptions of mining properties, have, on that account, been based partly upon the information obtained from an examination of the general geological features and the mining "tips"; partly also upon a perusal of the various official records [such as the Annual Reports of the Department of Mines, the Geological Records, the Mining Records, the Prospecting Board Papers, "The Industrial Progress of New South Wales, 1870," "Mines and Mineral Statistics, 1875," "The Mineral Products of New South Wales, 1887"], and partly, also, upon conversations with miners, mining engineers, and the Government Inspectors of Mines.

The accompanying report contains a general history of gold-mining in the Forbes-Parkes area, a description also of the physical geography, the general as well as the mining geology, and the methods adopted in working the numerous leads and quartz reefs.

Much greater prominence has been given to the history of this field than is customary in such reports. Emphasis has thus been laid on the fluctuating character of the mining, and a pessimistic view of it may possibly be avoided by a perusal of this chapter.

An area of about 500 square miles has been examined, a map of which has been prepared on a scale of an inch to the mile. Sections representing the Writer's interpretation of the geology of this field also accompany the report. Upon the map are indicated the approximate boundaries of the alluvium, the sedimentary rocks and the igneous rocks. The courses of the lodes and the "leads" are also indicated.

In a field such as the one under consideration, where the area of rock outcrops is relatively insignificant as compared with that of the associated alluvium and waste sheets, and where, moreover, the rock outcrops themselves are rather of the nature of low hills of gentle slope than of bold and rugged escarpments, it becomes a difficult matter to piece together the isolated scraps of information thus obtained, and to produce a connected story of the

geological events which have taken place in such an area. In attempting to map in the boundaries of the alluvium it was found that there had been several fluctuations of level in the river alluvium, and that one of the earlier terraces had been so dismantled as to appear in places merely as a gently sloping cloak of waste. On the map only the present alluvium boundaries have been indicated.

Nevertheless, even with these imperfect data, enough information has been collected to enable the boundaries of the various geological systems to be traced with a fair claim to accuracy. The area so mapped should form a starting point from which to make a general geological map of the whole of the Lachlan Gold-field.

I desire here to cordially thank Mr. J. Medlyn and Mr. Haselhurst, of Parkes, Mr. R. J. Barton, Mr. W. Hasemer, and Mr. Eddy, of Forbes, and Mr. R. M. Alexander, of Tichborne, for placing at my disposal much valuable information concerning the early history and the condition of mining of the field. I desire also to thank the managers and proprietors of the various mines both for general information received and for the use of mining plans and sections.

The maps and sections accompanying the report have been prepared by Mr. C. E. Murton, Field Assistant, under the superintendence of Mr. O. Trickett, L.S. I desire also to thank Mr. Murton for his cordial co-operation in the work. To him is due both the recognition of the Silurian conglomerate in the field and the securing of the greater portion of the collection of the Silurian fossils obtained in the area under consideration.

III.—HISTORY.

It will be advisable at the outset to indicate the relationship which the Forbes "gold rush" bears to the development of mining in Australia, seeing that the "rush" under consideration was but one only of a series which occurred both in New England and in southern New South Wales during the period extending from the years 1860 to 1870.

Stimulated by the sensational discoveries of gold on the Ovens and Mitta Mitta Rivers, the mining community explored the rough ranges at the heads of the Murray, Snowy, and Murrumbidgee Rivers. As a result alluvial gold was found at Kiandra in November, 1859, and from all directions miners then swarmed into this abode of wind and snow, even facing in their mad thirst for the precious metal the hardships of the Upper Murray route from Victoria. But, disappointed by the limited extent of the payable ground, and disheartened by the severity of the plateau winter, the greater number of the miners soon deserted the field, and shortly after their dispersal the rich alluvial deposits of Young (Lambing Flat) were worked. A population of 20,000* camped on the ground during 1861. Each miner, excited by the rapidity with which new fields were being discovered, sought to secure the richest wash dirt rapidly, always holding himself the while in readiness for a fresh "rush." When the news of the gold discovery at Forbes was announced, in the latter end of the same year, a great stream of men set towards that locality, and within three months 28,000 men were on the ground. 300,000 oz. of gold were won within two years, and then, hearing of the gold of the Shotover River in New Zealand in 1863, the miners passed away to this new Eldorado, leaving Forbes almost deserted.

* Pittman, E. F., *Mineral Resources of N. S. Wales*, p. 62.

Such are the main outlines of the history of gold mining in Australia at the commencement of the sixties—a history in which Forbes played no inconsiderable part.

Prior to 1861 the site of the Forbes township was occupied by a sheep run owned by Mr. T. Ranken.* In June of that year alluvial gold appears to have been found by Josiah Strickland about 50 or 60 yards above Fogarty's Hotel, as a result of intelligent prospecting. A new-comer named German Harry located the South Lead during the latter part of the year 1861. The lead was traced to the North Hill, and there called the North Lead, while its continuation to the Lachlan River was known as the South Lead. Upon the latter 82 claims had consecutively struck payable gold, the depth of the ground worked varying from 110 to 150 feet progressively, while, simultaneously with this, two or three irregular and patchy leads were traced from the South Lead towards the Britannia Reef. As early as 1861 the latter reef had been opened up to some extent by a miner named Sam Lewis, so that alluvial and reef gold had been found almost simultaneously.

In the days of the Gold Commissioners an area of ground 40 feet square only, per party of four, was allowed. This hampered the men in their prospecting operations, as will be seen later.

The area occupied by the alluvial gold of Forbes was not large; but so rich were the claims that an enormous "rush" set in to the place, and various observers estimate the number of miners on the field towards the close of 1861 as from 28,000 to 40,000 souls. According to Warden Dalton† it is possible that not more than "one-sixth of the people were actually occupied in mining operations. The remainder was made up of speculators, traders, mechanics, professional men, women and children, and camp followers, amongst whom the criminal classes were well represented." So dense was the crowd of miners washing pay dirt on the present site of the Forbes township that, according to Mr. R. J. Barton, one of the earliest arrivals, a walk along the position now occupied by Rankine-street could not be made under an hour's time. But as the ground was worked, the greater number of the men deserted the field. By Christmas Day, 1862, the population had been reduced to 12,000—the amount of gold transmitted during that year to the Mint by escort was estimated at 235,044 oz.—and by June, 1863, the population had dwindled to 3,500 souls, and the amount of gold won during the half-year was 50,819 oz. At this juncture the Shotover Gold-field was discovered, and Forbes then became practically deserted.

Naturally in such a limited area as that to which the payable gold of Forbes was restricted there were more disappointed than successful miners. Indeed, for every lucky "digger" there were ten who found nothing. [The Kiandra field had been still more disappointing in this respect.]

Very good order was maintained, considering the opportunities existing for evil-doing in such a large mining camp, as well as the fact that fewer than fifty police were stationed in the district. Robberies were of fairly frequent occurrence, but no horrifying punishments resulted, as at the mining camps in North America. It may be interesting here to note that at Kiandra a peculiar form of punishment attended convictions for minor

† Ann. Rept. Dept. Mines N. S. Wales for 1877, p. 76.

thefts, the culprits having their heads closely shaved.* At Forbes, certain reprehensible practices also were tolerated as affording an outlet for energies which might otherwise have been directed against the well-being of the community. Thus, where the Town Hall now stands, three or four parties would form a ring and win the money of the miners by various well-known tricks.

But of the elemental virtues possessed by the true miner not enough appears to have been made known. The story of the winning of the gold from the deep wet ground of the South, the Victoria and the Caledonian Leads, is one of absolute courage and determination: a story which helps to make history. Living under conditions of almost untold discomfort, menaced by unhygienic surroundings, they toiled on, taking all extremes with the same cheerful spirit. Limited in area to blocks forty feet square for each party of four, unable to erect powerful pumping machinery on the ground, forced to carry unwieldy and water-tight boxes through deep and water-logged drift (sometimes unaided by divers) so as to reach the deeper ground, forced to work waist-deep in water often, constantly in danger of being drowned, crushed or smothered, these men showed themselves resourceful to the last degree. Under such conditions were the richest portions of the main gutters won, the payable wash on the "rim rock," "reef rock" or "high bar" being neglected in the early days of the field, for men who knew that richer ground lay in front of them would not willingly lose time in bad ground in sending much poorer stuff to the surface. Single-handed, they knew they could not cope with the water and running ground; thus, when two parties were approaching each other along the "gutter," each hastened to work out the rich central ground, and then to vacate the claim so worked, preferring to leave the poorer "reef-wash" untouched to working it under almost impossible conditions.

The Victoria and Union Leads were opened up shortly after the discovery of the South Lead, and the King's, the Queen's and the Caledonian Leads a little later again. The Thompson, Mathieson and Bald Hill Leads were not known until a few years later.

A quotation from a report† of Mr. Warden Dalton, upon the early history of Forbes and Parkes is here reproduced, as it shows the manner in which the Parkes Gold-field was found. "During the year 1862 the gold-fields round Forbes had by degrees extended northwards to the Strickland Reefs, and within five miles of the Goobang Creek. As the main leads at Forbes now began to manifest signs of exhaustion, prospecting parties spread in advance of the occupied leads and mines, chiefly northerly. Amongst these were James Pugh and two others, who, crossing the Goobang in August of that year, during the ensuing October, discovered the Pioneer Reef, situated on a ridge about 10 miles distant from the nearest payable mines . . . a trial crushing of one ton of picked stone from the Pioneer produced 10 oz. 17 dwt. of gold. It was said to be payable. A rush ensued, and the result was the opening of several payable quartz reefs, payable from the grass. These reefs were occupied in quick succession, and were proved to be very rich near the surface, becoming less auriferous as they descended; and finally in the years 1866 and 1867 they ceased to be worked with profit, and were abandoned, when the miners removed to other gold-fields, and all trace of mining industry was gradually effaced.

* *Sydney Morning Herald*, 5th April, 1860.

† Report of 28th June, 1880.—Enclosures to N. S. Wales Parl. Papers, No. 10, 1881.

In the absence of reliable returns I estimate the quantity of gold won on the Billabong Gold-field, from the various quartz reefs, between October, 1862, and December, 1867, at about 40,000 oz."

The early history of these leads has been briefly described by Mr. E. F. Pittman, A.R.S.M., Government Geologist, and an extract from his description * is here reproduced :—"None of the *leads* were traced to their termination, owing to the difficulty of dealing with the water, and the fact that the small areas which were tenable under miners' rights did not warrant sufficient capital to provide proper machinery. To the north-west of the town of Forbes a shaft was put down to a depth of nearly 400 feet in very waterworn pliocene drift, but was not bottomed, and, consequently, this *lead* (the North Lead) was not tested where the indications were, perhaps, the most favourable. The size of the claims held on the alluvial *leads* was only 40 feet x 40 feet, and it is recorded that a party of six men worked out one of these claims on the South Lead in two months, during which period they won 1,900 oz. of gold. It is well known that in those days, when miners were always ready to start off for the scene of the latest (and, therefore, the most attractive) *rush*, the work, especially in deep *leads*, was hurriedly and imperfectly performed, and there is good reason for believing that in such gold-fields as Forbes the washdirt was in many instances only extracted from the main channels, leaving the *sile*, or *reef wash*, as well as that from the junctions of smaller tributaries, untouched. With the aid of suitable appliances, therefore, it is probable that much of the old ground would pay to work again. Quite a number of *leads* which have only been partially worked occur in this gold-field, and there can be little doubt that if they were developed further down their courses they would be found to junction with others not yet discovered."

The following extracts from the *Sydney Morning Herald* during the years 1860-1863, throw light upon the early mining conditions at both Forbes and Parkes :—

The diggings of the Western District have remained during the past month in their usual steady position, if we except a rush made upon Rankin's Station on the Lachlan River. Several large nuggets were found on a flat. . . . The result was a rush, in which great numbers from Lambing Flat joined. Recent intelligence, however, informs us that it has proved a perfect failure, and that all the Lambing Flat men have returned. [July 20, 1861.]

One party sank a shaft 10½ feet deep, and then came to 2 feet of washing stuff, and after washing twenty-three buckets of stuff they obtained 5 oz. 13 dwt. of gold. [September 6, 1861.]

One nugget weighing 11 oz. [September 17, 1861.]

There are 700 or 800 men at work there at the present time, who all seem in high spirits. [October 19, 1861.]

A person named Strickland had 32 ozs. of gold taken out of his tent at night while the inmates were asleep. [October 26, 1861.]

A lead has been struck, 180 feet wide, and it is now opened half-a-mile long; a hole was bottomed to-day, and a 1 lb. weight of gold was washed out of two tubs. [November 2, 1861.]

From the first discovery of this field, it attracted to the place more than ordinary importance, from the indication of a deep lead, the existence of which . . . would give to the field a character of permanence and comparative certainty in the operations hitherto, one may say, unknown in this colony, although such leads have formed one of the main features of the principal fields in Victoria. . . . The yield from the payable shafts has ranged from half-an-ounce to 8 oz. in the tub. . . . It is the only one (the South lead at Forbes, E.C.A.) in this colony, I believe, which has found favour with the miners from the superior fields of Victoria. [Extract from Commissioner Maclean's report, November 14, 1861.]

Some are so enthusiastic that they believe it will be a second Ballarat. . . . In one instance 82 oz. were obtained out of three tubs of wash. [November 16, 1861.]

The success met with on the Lachlan will naturally excite attention to a most promising district. For many years I have anticipated this success; for, as you will find by reference to the instructions received in 1851, in which were embodied the names of districts I had indicated to the Government beforehand, I pointed out the region, the Meridian Ranges, between 32° and 34° south latitude, and 146° and 149° east longitude, as deserving a search for gold. . . . [Extract from report of Rev. W. B. Clarke, November 16, 1861.]

The second lead, named the Victoria, is on the block system. [November 21, 1861.]

The price of gold is reduced from £3 15s. to £3 11s. per oz. [November 26, 1861.]

The lead at the northern end has been lost . . . Great number of shaft failures. Population estimated at 9,000. [November 28, 1861.]

Immense excitement and dismay was created here at the beginning of the month by the sudden loss of the lead. . . . At first everyone was in despair, and the commissioners for a time dreaded the effect that the news would have on the excitable minds of the miners. Luckily, however, before matters came to the worst, it was picked up at the southern end. [December 21, 1861.]

The Britannia Quartz Reef Company have been granted a prospecting claim. . . The loose surface soil is impregnated with gold. [December 27, 1861.]

The escort leaves this morning with 11,400 oz. This in reality only represents one week's amount, as upwards of 5,000 oz. of gold and £5,000 cash are left in the camp, the escort boxes not being large enough to contain the whole. [March 18, 1862.]

A nugget weighing 117 oz. has been found on the South Lead. [April 8, 1862.]

The Homeward Bound Claim, South Lead, commenced washing yesterday. Fifty loads of dirt produced 45 lb. of gold. [June 9, 1862.]

A rush has taken place to Billabong, about 20 miles distant [Parkes, E.C.A.], where a rich quartz reef has been found. [November 8, 1862.]

From the Billabong Reefs, a few samples have been crushed at Bell's machine, with following result:—2 tons from the Homeward Bound gave 4 oz 8½ dwt., and a similar quantity from the Pioneer 4½ oz. [January 15, 1863.]

The Billabong Reefs are turning out good stone, and in the course of another month or two we may expect to hear of at least three crushing machines at work there. [February 3, 1863.]

Heavy machinery is on the road for the Billabong Reefs. [February 18, 1863.]

In the early days of the district, namely, the years 1862, 1863 and 1864, the Billabong or Parkes Field was noted for its quartz lodes. These were the Pioneer (1862), the Day-spring (1863), the Bushman, the Golden Bar (1863), the Welcome, the Black Snake, Steel's, Strickland's and the associated lodes. Near the surface the values were from 2 to 3 oz. of gold to the ton of stone; but at depths of from 150 to 180 feet the lodes were temporarily abandoned, the miners considering them unpayable at these depths.

From 1867 to 1871 the gold-mining industry at Forbes and Parkes was at a low ebb; the old village of Currajong on the Parkes Field contained only three or four houses, and the crushing plants had all been removed with one exception. About the close of the year 1871, however, a party of prospectors found the No Mistake Lead, an old buried stream channel, distant about 4 miles north-west of the present town of Parkes. Within twelve months the Bushman, Welcome, Great Northern and other rich gold-bearing leads were not only being worked but were paying well. The town of Bushman was formed at this time, and its population within a remarkably short space of time had increased to 6,000 souls. Two years later it had increased to 8,000, and the name of the town was altered from Bushman to Parkes, in honor of the great Australian statesman of that name. The quantity of gold won from the Parkes alluvial workings during the period 1871–1873 is estimated at 50,000 oz.

It was only to be expected that this great success of alluvial mining should be accompanied by a determined search for lodes from which the alluvial gold had been shed. But with this enterprise the inevitable speculators and mining "boomsters" were associated, until it became difficult to distinguish

between genuine and false mining ventures. During the year 1872 the mania for "floating" mines is said to have been at its height*. Nevertheless during the whole of this time the work of alluvial prospecting was progressing, and in 1872 the main Welcome Lead was discovered, its tributary, the Tearaway, being found the following year. This tributary lead it was which was famed for its large "nuggets." In 1874 individual nuggets were recorded, as much as 7, 25, 35, 37 and 134 oz. in weight, while as late as 1876 pieces weighing as much as 30 oz. were still being unearthed.

The year 1874, however, marked a still brighter stage in the history of gold mining in the Parkes District. The mining community, disappointed in its endeavours to trace the Welcome, the Great Northern, and other leads across the Billabong or Goobang Creek, began to look round for other and more promising fields. At this time the fame of the Palmer Gold-field, in North Queensland, spread like wildfire, and the mining settlement of Parkes, among others, supplied the new and distant field with many of its best men, and the population dwindled to about 500 souls. This loss to the Parkes population was, however, only temporary, for on the 8th March, 1874, M'Guiggan and party obtained good prospects from a shaft 45 feet deep in the alluvium and distant about five miles south-west of the present town of Parkes. This find was the commencement of the famous M'Guiggan's Lead, perhaps the most important discovery made on the Billabong Gold-field, not only on account of its own intrinsic value, but also because it was the signal for the magnificent prospecting campaign which was to result in the rapid discovery of the group of leads known as the London, the Ben Nevis, the Tichborne, the Fairy and the Wapping Butcher. Men returned in great numbers from the Palmer and other fields, and within three months after the discovery of the M'Guiggan Lead the district had a population exceeding 10,000 people. The vivid description by Mr. Warden Dalton of the excitement caused by the successful prospecting of the alluvial plain at Tichborne during this period is here reproduced:—
 " hundreds of shepherds followed, who occupied long lines of imaginary leads in anticipation of the red flag. Land speculators also followed like sharks in their wake, and suddenly discovered that a waterless country that had been permitted to lie unoccupied by permanent settlers . . . was the only place where they could erect homesteads. . . . The swinging of base lines was incessant, and no little confusion and litigation was the result. In fact, the operations of the miners on these wide levels appeared more like the evolutions of an army in the field than anything else. Marking claims had resolved itself into a game of chess." †

To the accompaniment of such doings, the leads were located one by one. The Ben Nevis was discovered during the same month as the M'Guiggan Lead, and the London Lead was found a month later, while the group known as the Fairy, the Tichborne, and the Wapping Butcher Leads were first worked in November of the same year. The names of these leads recall to mind the well-known "Tichborne Case," which was occupying the minds of men at that time. With the opening of these alluvial deposits, the town of Tichborne sprang full-grown into being near by, and so important were the finds considered to be, that the Australian Joint Stock and Commercial Banks, as well as the Bank of New South Wales, each opened "branches" at the new town, exclusively for the purchase of gold. Great numbers of energetic men also came to Parkes, and the old straggling

* Margules, Ann. Rept. Dep. Mines N. S. Wales for 1876, p. 89.

† Mines and Mineral Statistics, 1875, p. 31.

mining village was rapidly transformed into an attractive and prosperous town. Many of the yields from these buried stream channels were remarkable, and some of the gutters produced many large nuggets. The ground worked varied from a few feet to 200 feet in depth. The wash varied from one foot to 16 feet in thickness, and its width at times exceeded 200 feet, while the general expenses attached to raising and treating the wash averaged ten shillings per load. The following returns have been selected from the Annual Reports of the Warden and the Mining Registrar for the years 1875 and 1876. Thus, in the year 1876 the three prospecting claims on the M'Guiggan's Lead produced the following returns:—

		Oz. gold.
(1) M'Guiggan's	3,567 loads for	2,140
(2) M'Gee's	1,372 „	1,372
(3) Cook's	3,250 „	1,950
Total	8,189	5,300

On the Tichborne one party of four won 1,700 oz. of gold during 1875. The Frenchman's block had wash 17 feet thick, and four men realised £5,000 from the treatment of 5,000 loads.

On the Wapping Butcher, one claim 10 chains square and worked by a party of four yielded 1,050 oz. of gold. Four others from an adjoining claim raised £4,000 worth of gold during the same period. An adjoining small claim gave 2,707 oz. from the cleaning up of 1,005 loads of dirt, "Carroll and party, with 1,200 loads, yielded 1,600 oz., amongst which were many nuggets from 2 dwt. up to 18 oz., several 5 and 7 oz. in weight. Farrell and party, 2,200 loads, with a yield of 1,543 oz., many nuggets mostly weighing 5 and 6 oz., the largest being 16 oz. 10 dwt. Messrs. Barlow and party, 600 loads, 450 oz., and from cement 84 oz., making 534 oz. in all. Messrs. Jones and party have already washed 1,306 loads, yielding 2,912 oz. 12 dwt, and had several nuggets of various weights. This party has about 1,000 loads to grass waiting for water to puddle. Messrs. Murphy and party had a large amount of dirt, some yielding 2 oz. to the load; also cement with fine results and nuggets up to 20 oz.*

"Harrison's claim (Fairy Lead, E.C.A.), yielded† 695 oz. to 1,400 loads; amongst the gold was the nugget, now at the Department of Mines, weighing 19 oz 12 dwt. Barnett and party had 1,070 oz. to 1,390 loads, showing several specimens, one weighing 16 oz."

In passing it may be noted that the Bald Hill Lead at Forbes was opened up at the same time that these wonderful yields were being obtained at Parkes and Tichborne.

Great difficulty was experienced by the miners in tracing the leads as they approached the course of the Billabong Creek. It will be seen by a reference to the general map that the majority of the main leads have been traced almost or quite as far as the Billabong Creek, but with the notable exceptions of the Wapping Butcher, Tichborne and M'Guiggan's South, they almost invariably ceased to be payable as they passed beneath the present creek bed. Indeed, some leads, such as the London and Ben Nevis, ceased to be payable long before reaching the creek. It was ascertained also that the channels were wider and less well defined as they were followed down stream, and that their bottoms partook more of the nature

* Margules' Ann. Rept. Dept. Mines N. S. Wales for 1875, p. 87.

† *Ibid.*, p. 87.

of "gilgais," the gold contents being found rather on the tops of the "gilgais" than in the basins. This is the testimony of the miners themselves. The South Lead also at Forbes was unproductive, as soon as it had passed vertically beneath the Lachlan River, while the Victoria and Caledonian Leads failed to pay before they reached the main stream channel. Large sums of money, however, were spent in attempting both to trace the channels of these leads and to prove them payable, as they approached the main drainage line of the locality.

For a period of almost 16 years the leads of Forbes had lain idle, while the mining timbers and workings gradually fell more and more into a state of disrepair. Nevertheless, it was believed that the richest portions only of the Forbes Leads had been worked out in the early days, and Mr. Warden Dalton* and Mr. Phillip Davies† called attention both to this fact and also to the necessity for examination of the "rim rock" (sides of the channel), in the hope of finding payable gold there. Mr. Davies showed how the "alluvial" of Forbes, particularly that of the South Lead, had been only partially worked for many thousands of feet during the years 1862-1864; how, owing to the great amount of wet drift, the miners had been unable to cope with the difficulties attendant on mining at a depth of 200 feet below the main water channel of the district, by reason of the disabilities they laboured under, especially in connection with the small area (40 feet square) allowed to each claim by law in the early days. In addition to this, attention was drawn by him to the fact that while money was being spent freely in "floating" quartz-mines of doubtful value, very little money, comparatively, had been spent on alluvial mining. He also pointed out how reefs had been unearthed by an energetic search for alluvial gold, and he instanced the wonderful history of the Ballarat and Bendigo fields in this connection. One extract‡ from his clearly-worded report is here reproduced:—"Strange to say, just at the time when the alluvial diggings of Parkes were discovered, the great mania in quartz speculations was at its highest pitch of excitement; nevertheless, none of the public companies that were formed in Sydney ever spent a shilling on the alluvial holdings, but it is well known that a number of valueless quartz companies were floated in that district that had not the shadow of a chance of ever paying a dividend. But what was the result as regards the alluvial of the same district? The latter class of mining produced at the rate of from six to eight thousand oz. of gold per month for nearly four years, and afforded immense profit to the individual miner without the outlay of any capital worth mentioning. One little alluvial claim designated the Welshman's, on the Wapping Butcher, produced 3,306 loads of wash dirt, yielding 6,912 oz. 12 dwt., or an average of over 2 oz. per load. The expense attached to the working of the claim, including capital to commence operations, is estimated at 10s. per load, but all the quartz companies that were floated in the district, at about £180,000, only paid about £7,000 dividend, and that mostly out of subscribed capital. Yet . . . the capitalists will insist upon speculating in what I call phantom quartz mines."

Mr. Davies then made an effort to work the South Lead himself, and by the close of 1879 he had put down a shaft 250 feet deep, excavated a chamber, driven 300 feet of lower main levels, and put in 1500 feet of drives in the wash dirt. One lot of 900 tons yielded 204 oz. of gold. The water was troublesome, making at the rate of 72,000 gallons a day for nine months. This trial was only partially successful, and in 1880 most of the miners deserted the field and left for Temora, Mount Poole, and Mount McDonald.

* Ann. Rept. Dept. Mines N. S. Wales for 1877, pp. 74-77. † *Ibid.*, pp. 82-84.

‡ Ann. Rept. Dept. Mines N. S. Wales for 1877, p. 86.

The deeper portions of the Parkes leads had also been exploited at this time. The details of these attempts will be found discussed in the chapter dealing with the leads.

Just about the time (1876-1877) when Mr. Warden Dalton and Mr. Phillip Davies were urging the necessity of working the alluvial, so as thereby to unearth any reefs hidden under the overburden of river drift, it was reported that the miners had located reefs at a depth of 90 feet from the surface by sinking on the Bushman Lead of Parkes. These reefs were afterwards to become important producers of gold, but in the meantime very little mining, with the notable exception of the working of the Bonnie Dundee by Medlyn Brothers, appears to have been done either at Parkes or at Forbes between the years 1878 and 1883.

In the early part of 1886 several rushes took place to the large alluvial flat near Tichborne, known as Scrubby Plains. The "Abbott Rush" of June, 1886, was one of these. The gold found in all the scrubby plains leads, however, proved to be very patchy. At the same time the South Lead of Forbes was again taken up, and three companies were formed, whose claims were called the Nil Desperandum, the Forbes Alluvial Gold Mining Company, and the Crinoline. The results, however, attending these ventures were far from encouraging, and the companies just named suspended work about the year 1889.

It will now be necessary to retrace our steps a little, so as to understand the important developments which had been taking place at Parkes during the early part of the period extending from 1880 to 1890. At the same time it illustrates the difficulty under which the miner labours, and the immense hope and courage he must be possessed of when exploiting new ground. Incidentally, also, it throws light on the constant conflict of interests existing between the Lands and Mines Departments, and the difficulty experienced in adjudging the respective claims of the two Departments impartially.

It appears that most of the area containing the Quayle's, the Phoenix, the Gladstone, the Bonnie Dundee, and the associated mines was formerly leased to a public company, which abandoned the land after a trial of the lodes. Many of the inhabitants of Parkes at this stage considered that the best interests of the town would be served by disposing of this old mining site in small private allotments. The Department of Mines, however, retained the land, taking the view that the lodes known to exist under the alluvium had not been sufficiently tested to justify the alienation of the land. The Department of Mines still retaining the land in 1883, a Mr. Haselhurst took up an extended claim, 200 feet by 400 feet, on the line of lode known as the "Buchanan." He sank a shaft 80 feet deep on the Bushman's Lead, and exposed the "Buchanan Reef" in the bottom of the shaft. The stone there, however, was not payable. He then entered an old shaft on the line of lode and drove 38 feet along the lode, but was unsuccessful. Next, by examining the old spoil heaps around he finally obtained some "colours" near the old shaft just mentioned. He concluded that it must have come from an old drive opening out of the shaft in which he had been working. Having proved this supposition to be correct, he found a "leader" only six inches in width, which, however, contained a little gold. He could only drive a short distance in one direction without entering another claim, while at the other end the "leader" had apparently died out. By driving on this, however, he obtained good prospects. From 13 tons of stone he procured 39 oz. of gold. A shoot of payable stone 120 feet in length was then opened up, which yielded splendid results. Up till December, 1887, it had yielded 6,528 oz. of gold from 1,383 tons of stone. In all, about £60,000 worth of gold was obtained from it. In 1890 the mine was sold for £20,000 to the Haselhurst's Proprietary Company.

Another sign of the revival of quartz mining in this district was the erection of two large crushing plants at Parkes during this period.

In the year 1893 another attempt was made to work the South Lead at Forbes, which had been lying idle almost continually for several years. Some good wash-dirt was obtained, but the results were not generally satisfactory. Just before this (1892) the Bushman Reef of Parkes had been again opened up. The mine had been practically abandoned since the work done on it in the early days of the field, and the adjacent land also appears to have been included in that which had been sought at various times for residential purposes, but had been retained by the Department of Mines. A small party of miners during this year (1892) won 774 oz. from 378 tons of stone. In 1893, £5,273 worth of gold was won, and a party of tributors during 1894 recovered 3,972 oz. of gold from 1,558 tons of stone. Between the dates 1892 and 1898 at least 17,382 tons of stone had been treated for a yield of about 18,000 oz. of gold. These returns may be incomplete, for Mr. J. Wann informs me that 25,000 oz. gold were won from the middle levels of the Bushman Lode between the dates 1892 and 1900. By the same authority I am informed that the upper workings along this lode yielded from 25,000 to 30,000 oz. of gold in the early days of the field.

Other lodes such as the Dayspring and the Koh-i-noor were also being worked in Parkes at this time, and during the four years ending 30th December, 1893, the Parkes lodes had yielded £135,563 worth of gold from 37,796 tons of stone. All this and an equally large amount of gold from the Buchanan and related lines had thus been obtained in a short space of time from land which was thought to be useless from the point of view of mining.

It will now be interesting to follow the history of mining at Forbes about this period. After the failure to work the deep leads successfully during the period 1886-1888, no mining operations of importance were carried on for a considerable period of time, but in 1896 another important stage was reached when an ironstone outcrop situated in a large alluvial flat about three miles north of Forbes was prospected for gold. A claim was applied for. Possession was taken on the 25th August, 1896, and a survey of it was made on the 10th October, 1896. This was the start of the famous Lachlan Mines. Gold being found, it was decided to sink on the ironstone. This was done, and with the proceeds obtained as the result of this work the prospectors determined to form a company. The latter was formed in 1897 and called the "Lachlan Gold Fields Company, Ltd." By 1898 about 2,088 oz. of gold had been won, and in 1899 5,613 tons of stone were treated for a return of 4,287 oz. of gold. Again in 1902 gold to the value of £22,103 was won, while in 1903 as much as £24,882 worth of gold was recovered. By this time a shaft 500 feet deep had been sunk; long drives had been run along the vein, and men to the number of 87 were this year in constant employment about the mine.

In 1901 the continuation to the north of the Lachlan Reef was opened up and named the Nil Desperandum. To work it a company was formed with a capital of £6,250. By the close of 1903 a sum of money as large as £15,600 had been expended in opening up this line of lode, and machinery had been erected at an estimated cost of £5,840. The prospects of this mine, however, were never so bright as those of its neighbour to the immediate south. Meanwhile interest was now being centred round the continuation of the same line of lode still farther to the north. The Bald Hill Lead had been traced towards this line of lode years before, and the existence of the lode itself had been predicted by the alluvial miners. The lode was located finally under 35 feet of alluvium, and in May, 1902, the Hauraki Gold

Mining Company was formed to work it. Another company, however (the North Lachlan Gold Mining Company) was formed in 1904. 5,036 tons of stone were treated during this year, for a return of 2,062 oz. gold, exclusive of slime values, while in 1905 the amount of stone treated was 5,825 tons, and the yield of gold from such treatment was 3,786 oz. The value of the machinery erected was £10,500.

Since the year 1907 mining at both Forbes and Parkes has been at a very low ebb. Notwithstanding this stagnation of the mining industry to-day, a careful perusal of the history herewith furnished (and lengthened purposely so as to bring into prominence this intermittent character of the mining) will tend to counteract the pessimistic view existing at present as to the future of the mining industry at Forbes and Parkes. An epitome of the history may make this clear. First we have the rush to the Forbes alluvial in 1861; the extraction of fully 300,000 oz. of gold from the deep wet leads; the exodus thence to the Shotover (N.Z.) during 1863; the discovery of the Parkes or Billabong reefs in 1862, and the profitable working of the same up till 1864; the apparent failure of these reefs and leads to be productive at depths greater than 200 feet; the departure of the miners for Grenfell in 1867, as well as for the Palmer in the early "seventies." Then we have the discovery of the No Mistake lead in 1871, and that of the Welcome in 1872; then the period of depression in 1873, followed by the grand awakening in 1874 on account of the discovery of the group of leads (of which M'Guiggan's is the type) in an area long supposed to have been exhausted by all but the most sanguine of the mining community. New towns sprang into existence as if by magic, and miners were once more thrown into a state of wild excitement. From the leads of the Parkes-Tichborne district about 200,000 oz. of gold were recovered. Then came the darker days at the close of the "seventies," and during the early part of the "eighties." The early quartz-mining companies of Parkes and Forbes had failed; the people sought to alienate the mining reserve around the Phoenix and the Bushman Mines, but the Department of Mines remained firm, and retained the land in the mining reserve, and in a few years their action was justified by the development of the Haselhurst Lode, one mine along which produced £60,000 worth of gold between the years 1883 and 1892. In 1892 the Bushman Lode was re-opened, and produced even more startling results than had the Bushman Lode. The Koh-i-noor and Dayspring also produced splendid results during this period. The last important attempt was made at Forbes in 1896, when the Lachlan line of lode became a consistent and splendid producer of gold. Now, in 1910, men's thoughts are being directed to agricultural pursuits because the mining outlook is so very depressing. The present state of inactivity is not more pronounced, however, than it was in the late "sixties" and the late "seventies." There is a tendency to magnify the present depressed state of mining affairs, and to cast a halo of romance round the early mining days by minimising its failures and remembering only its successes. This is only a necessity of perspective, and may be compared to a view taken of a straight line of telegraph posts, where the observer sees the posts in his vicinity to be well separated, while those in the distance appear to be crowded together. These fields in the early days had their trials, their periods of inactivity, just as acutely felt then as is the one to-day. One cannot say that Parkes and Forbes, as mining fields, will become as important as before, but this one can say, that the auriferous belt has not yet been sufficiently prospected, especially beneath the cover of alluvium, to justify any serious doubt as to its future revival as a successful mining field. Until the known auriferous belt shall

have been thoroughly prospected history here may repeat itself, and the present period of mining depression be followed by the discovery of some lead or lode hitherto unsuspected. Or again, some well known lode may be ascertained to contain a rich shoot of gold hitherto unknown. In any case, with so great a development of alluvium, as yet not completely tested, there is always hope for, and probability of, the discovery of fresh payable lodes.

IV.—GOLD YIELDS FOR PARKES AND FORBES.

Year.	Oz.	Value.	Locality.	Source of Information.
1861	4,151	.....	Forbes only.	
1862	212,547	.. ..	" "
1863	71,493	.....	.....
1864	18,722	.....	.....
1865	9,869	.. ..	.....
1866	16,503	.....	.....
1867	7,746	.....	.....
1868	3,067	.....	.....
1869	1,583	.....	.....
1870	...	.....	.....
1871	50,629	.....	Parkes—3 years. Forbes, 629 oz.	
1872				
1873				
1874				
1875	57,851	.....	Parkes & Forbes. (533 oz., Forbes).	
1876	24,106	.....	Parkes only.	
1877	9,399	.....	" "
1878	5,147	.....	" "
1879	4,472	.....	Parkes & Forbes.	
1880	5,006	.....	" "	Mining Registrar's Reports
1881	4,131	.....	" "	" " "
1882	3,126	.....	Parkes only	" " "
1883	3,000	.....	" "
1884	3,951	.....	Parkes & Forbes	
1885	7,246	.....	" "	Mining Registrar's Reports
1886	5,731	.....	" "	" " "
1887	6,611	.....	" "	" " "
1888	5,231	.....	" "	" " "
1889	10,544	.. ..	.....	Mint Returns
1890	11,547	.....	.....	" "
1891	9,695	.....	Forbes almost nil	" "
1892	7,354	.....	.. ..	" "
1893	7,282	.....	.....	" "
1894	9,746	.....	Forbes, about 87 oz.	Mining Registrar and Warden's Reports
1895	10,672	.....	.....	" "
1896	12,514	.....	Forbes, no returns	Mining Registrar's Reports
1897	11,145	.....	Forbes, 28 oz.	Mint Returns
1898	12,694	.....	.....	" "
1899	11,056	.....	.....	Mining Registrar's Reports
1900	11,298	.....	.....	" " "
1901	8,498	.....	.....	" " "
1902	7,770	.....	.....	" " "
1903	11,580	£46,204	.....	" " "
1904	14,913	£60,442	.....
1905	13,721	£53,114	.....
1906	10,074	£42,193	.....
1907	3,329	£12,231	.....
1908	1,756	£6,218	.....
1909	2,531	£8,771	Forbes, 1,626 oz.	

V.—PHYSICAL GEOGRAPHY.

Parkes is distant 272, and Forbes 292 miles by rail from Sydney, *via* Molong, Forbes being 20 miles south of the sister town. Forbes is 783 feet above sea level, and has an approximate population of 5,000 people, while Parkes is 1,035 feet above the sea, and has a population of about 3,000 souls. The heights here given are those of the respective railway stations, and the populations are those of the municipalities only. Each is the centre of a populous district, wheat and wool growing being the main industries. Originally mining was the main support of both districts, but of recent years the agricultural and pastoral interests have altogether overshadowed those of mining. Last year about 30,000 acres were reported to be under wheat at Forbes, and from 40,000 to 50,000 acres in the Parkes district. The soil is admirably adapted for wheat growing, but the rainfall cannot be depended upon. The amount of rain which falls would doubtless be sufficient if it fell at the proper time, but falling often at the wrong time, and failing to fall altogether during certain irregularly-spaced periods, the land to a great extent still lies in its primitive state. The average rainfall at Forbes is 20.01 inches, and at Parkes is 21.54 inches. The maximum and minimum temperatures respectively for Forbes and Parkes are 118.4° and 24° in the former, and 114.9° and 20° in the latter case. The amount of evaporation during the summer months is enormous, and the dry westerly winds are also great desiccating agents during the whole year.

Two principal classes of soil occur—one, a thick waste sheet of exceedingly gentle slope, often extending from the alluvium proper up to the very summits of the low hills which rise from the plains. This is a brown or red loam, and much sought by the wheat grower. In many places it is almost impossible to distinguish it in mass from the associated but lower alluvial plains by the unaided eye, and frequently when mapping in alluvium one relies on its prevailing brick-red to chocolate colour to distinguish it from the sticky black clay of the associated alluvial plain. Along the Lachlan River the broad mass of true alluvium does not appear to be so well suited for wheat-growing purposes (under the present conditions of farming) as are the gentle waste-sheet slopes.

Vegetation.—The river red-gum (*Eucalyptus rostrata*) frequents the banks of the main watercourses, while the alluvial plain skirting the river is covered with open forest growths of magnificent specimens of Yellow Jacket (*E. melliodora*), Fuzzybox (*E. conica*) and *Acacia decurrens*. On the ridges and in the interstream areas generally one finds Red-gum (*E. tereticornis*), Bimble-box (*E. populifolia*), Narrow-leaved Box (*E. Woollsiana*), White-box (*E. albens*), Brittle Red-gum (*E. dealbata*), She-oak (*Casuarina stricta*) and *Acacia decora*, while on the Gilgai country one commonly finds Yarran (*Acacia homalophylla*), Myall (*Acacia pectulata*), Bull-oak (*Casuarina Luehmanni*), White or Red Wood (*Heterodendron olivifolium*). The botany, in brief, is that which characterises the warm dry climate of the central division of the State of New South Wales.

For a more detailed account of the vegetation of this area, the reader is referred to the botanical papers of Mr. R. H. Cambage.*

* *Proc. Linn. Soc. N. S. Wales*, 1901 ; xxvi, p. 317-333 ; 635-699.

Geographical position.—The Forbes-Parkes district lies neither upon the tableland nor upon the great inland "Black-soil" plain, but occupies a position intermediate to the two, one nearer, however, to the broad and gently sloping plain than to the upland. The average height of the tableland to the east of the subject area slightly exceeds 3,000 feet, while the great "Black-soil plain"* commences near Lake Cudgellico and Narrandera, which lie about 600 feet above sea level. To one approaching Forbes across the mirage-haunted plain of the west it would be seen, as Condobolin were left behind, that the monotonous sweep of plain had suddenly become diversified with islands of rock, and that the plain had sent long broad tongues of alluvium into the ranges, the tongues ever diminishing in size, and the mountains ever crowding more and more closely, the one upon the other, until at some distance west of Forbes they had become welded together to form a high continuous or plateau surface. On the other hand, to one approaching Forbes from the highlands, back of Mt. Macdonald, the plateau would be observed to be deeply trencched at first with a network of gorges which, followed westwards, gradually coalesce to form the mighty valley of the Lachlan, ever broadening with increasing progress westwards. With the approach of the Great Plains the mountain piles would be observed to dwindle in height; to become more and more isolated; their profiles would become more and more gentle; the cloak of waste would be seen clinging to their sides, the alluvium growing wider, and the hills would appear to be buried first to their ankles, then to their knees and their waists, until finally the last knob had disappeared beneath the sea of alluvium.

The main topographical facts of this region, then, are as follows:—

- (a) A tableland to the east.
- (b) A "Black-soil," or Piedmont, plain to the west.
- (c) A dismantled tableland in the intermediate area (that is, Forbes and Parkes) diversified by broad valleys, with deeply alluviated bottoms.

Upon a closer examination, however, it is evident that a multitude of details modify the main topographical features just enumerated.

For instance, it is evident that a long valley exists continuously through from Parkes to Peak Hill, its eastern wall being marked by the steep Harvey and Bumbery Ranges†. To the west the long north-and-south quartzite ridge, pierced by the Jemalong, Goobang, and Bogan Gate Gaps, forms a western wall to this valley, which either was tributary to the Lachlan or the Bogan River. Several distinct, although dismantled, rock platforms evidently exist in the lower portions of this valley. Thus, the low and narrow rock bench, about 50 or 75 feet above the Billabong Creek, on which the main town of Parkes is built, and which follows the right hand bank of the creek for some distance below the Molong road crossing, evidently represents portion of a recent valley floor of the Billabong Creek. A view from any of the many minor trigonometrical stations around Forbes and Parkes suggests the idea that all such stations are situated upon remnants of another old valley floor of the Lachlan and its tributary the Billabong Creek, the older floor remnants under consideration being several hundreds of feet higher than the associated stream levels of to-day. One large remnant of this old valley floor is especially well preserved in the neighbourhood of the water-shed of the Bogan River and the Billabong Creek.

* Geographically, such a plain is known as a Piedmont Plain.

† This mountain range marks the line of a recent fault.

While travelling along the road from Parkes to Alectown, one passes for miles over this recent valley floor. The higher ground between Darroobalgie and Tichborne is also a remnant of a former valley floor. All around one may notice traces of a still older floor, while in the neighbourhood of Parkes one has abundant evidence of the existence of an old valley floor intermediate in age between the two just described. Remnants of at least four of these old valley floors may be seen in the neighbourhood of Parkes and the watershed of the Bogan and Billabong watercourses. All, however, are distinctly enclosed by the high and widely-separated quartzitic and granitic walls of the main valley. Above Eugowra again may be seen the remnant of an old valley floor of the Lichlan carved out of granite and lying about 700 feet above the bed of the present main water channel. Nevertheless the casual observer may not recognise these benches as remnants of old valley bottoms, because the effect on them by later stream action has been so marked that fragments only of them remain among the harder rocks, the portions of the valley bases formed of softer rocks having been completely removed. However, one may see that the old rock benches and low flat-topped hills have at one time formed continuous surfaces, and when one examines the Bogan-Billabong watershed one can read even at a glance the story of the repeated formation of valleys, the one under the other. Away from these watersheds, however, the rock outcrops are mainly confined to low hills running North and South for distances as great as 20 miles—this, however, only in exceptional cases.

This is not the complete tale of the formation of valley floors one below the other within the same grand enclosing walls, for the existence of other and lower channels has been revealed by the operations of the alluvial miner. Around Parkes old watercourses are found from 50 to 100 feet below the present surface of the alluvium; near Tichborne itself the old channels lie from 100 to 150 feet below the present surface of the black-soil plain; the famous South lead of Forbes has its channel as far below the surface as 210 feet, while Mr. Warden Dalton, in 1876, reported * “that a channel in the older tertiary drift crosses the richest portion of the gold-field, and at a depth of 330 feet has not been bottomed—that that channel must in ancient times have received the local drainage, and that the leads discovered were in all probability tributary to it.”

These deep leads are in turn divisible into a younger and an older group of stream channels. In proof of this the following clear statement of Mr. Warden Dalton may be quoted † :—“The London Lead, about three miles long, but only occupied now and during the past year, at the head is from 35 to 83 feet deep as far as No. 21; below that claim a channel 160 to 170 feet deep crosses the lead, or what may hereafter prove to be the bench workings. This channel has recently been found to contain a poor wash-drift about 8 feet in thickness; whether this is payable has not been ascertained. The existence of this main watercourse has been long known, as it was discovered on the first opening of the lead; it has been also found to cross the Ben Nevis Lead half-a-mile further to the west On the opposite bank of this deep ground the depth decreases to between 80 and 90 feet”

The following extracts on the subject of buried valleys are taken from a report of Mr. Margules.‡ “By several shafts it was ascertained that the ground [The Ben Nevis E. C. A.] has sudden descents from 25 feet to 120 feet in less than half-a-mile; then again it ascends as suddenly to less than

* Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 75.

† *I. d.*, 1877, p. 80.

‡ *Ibid.*, 1876, pp. 83 & 84.

100 feet, and so on, within a very short distance, while a belt of older amygdaloidal basalt, called by the miners "tertiary bottom," crosses the lead from north to south, the Ben Nevis' run of gold being south-east to north-west. . . ."

" Some shallower ground was traced westwards at a depth of about 82 feet, to the left of the shaft 150 feet deep—the wash seemed lodged on a plateau."

Evidence of valley levels again exists in the profiles developed in the alluvium itself. For example, the recent alluvium may be well seen about 7 miles west of Forbes, where it is traversed by the Condobolin-road, following the right-hand bank of the Lachlan River. A sudden rise of from 7 to 10 feet brings one into the upper and main mass of the "black soil." In traversing this upper alluvium in turn one frequently finds banks and irregularly-shaped masses of sand and stiff black clay rising from 20 to 25 feet above the general level of the plain. The large sand heap, about 30 acres in extent, on which Raymond's vineyard is situated, is an example. A flat-topped hill of black soil about one mile in length, which occurs about 6 or 7 miles out of Forbes, along the Eugowra-road, is another example. The long and gentle red soil slopes, almost indistinguishable to the unaided eye from the associated black soil plain, are also remnants of this older and upper alluvium. The "gilgai" country also frequently marks one of the dismantled "alluvium" level.

Such being the main facts of observation, a simple explanation of the phenomena may be advanced. It is well known that when two fragments or masses of earth material are dragged across each other a mutual loss is sustained in volume, the stronger fragment suffering considerably less from the action than the weaker. It will thus be seen that a stream, when armed with a load of stones and sand, must wear away any point of the base of the channel along which it flows so long as it is able to move its load of debris as a whole over the point in question. On the other hand, as soon as it becomes incompetent to move its load, as a whole, over any particular point of its channel base, it becomes unable to cut into it at that point, because some of the material falls out on to the channel base there, instead of being dragged over it, and thus actually protects it. That is to say, in this case it will alluviate or fill up its channel instead of cutting it deeper. Now the latter is exactly what the Lachlan system has been doing in recent geographical times, that is, it has been definitely proved (by mining operations) to possess decided rockbound channels all now buried for several hundreds of feet under the present alluvium. Whichever way we look at the problem we see that a mass of alluvium has been brought downwards by the streams, and that the old channels have been choked up along their lower portions.

When a land surface is elevated, its streams necessarily have a steeper path either to the water basin into which they flow, or on to the plain at the mountain feet, than they had before such elevation took place. It is easily seen, therefore, that this steeper run to the goal will induce in them a greater velocity than heretofore. But because they have at this stage an increased velocity, they also have a greater power of transportation. But we know that when earth material is rolled over other earth material the both cause mutual loss to each other; thus the mass of pebbles and sand rolled along the channel base becomes less and less in size, but in doing so it cuts gutters or channels into the earth's surface. He who would see such cutting of channels should not examine the streams when they are

in the low or drought stage, but should rather study them during the action of violent and protracted rain storms. The important point, however, to notice is this, if streams could make channels or valleys in the old land surface, then, upon a decided elevation of the same land surface they will have even greater power than before; and all other things being equal they will proceed to cut deep and steep sided valleys along their old floors. If the land elevation has been only moderate in amount the streams will gain a moderate increase in power only, and they will cut deeper channels along their old courses; nevertheless, not so deep as those cut in the land which has been lifted to a great height.

On the other hand, if the land sinks, then the streams will flow still more slowly, and hence more feebly, than heretofore. Thus the channel bottoms at this stage, instead of being cut away, as heretofore, will be buried under alluvium.

And, again, if a series of volcanic flows should dam the river valleys—say, for example, the Lachlan, below Forbes—then the stream channels would also be filled gradually up in this manner to the level of the uppermost lava flow, just as a dam is gradually filled with debris.

Conversely, if we see valley channels cut out of the floors of other and older valleys, or if we see definite rock-bound channels now occupied by alluvium, we are justified in assuming that in the first case an elevation of that district has taken place which has caused the streams to cut their channels deeper than formerly; and in the second case that subsidence has taken place, or that lava flows have dammed the courses of the streams.

But in the case of the Forbes and Parkes districts there is no evidence to show that the mouths of their draining streams have been dammed in recent times by lava flows, while there is abundant evidence both of elevation and sinking of the land in late and recent geological time. It is highly probable, then, that at a certain period in late geological times the region from Orange to that west of Condobolin was elevated and tilted to the west, and that the Lachlan streams gained greater power thereby, and gradually excavated the mighty Lachlan Valley out of the plateau. At various times this land surface rose slowly, and each time that it did so the streams excavated a valley floor below the previously formed one. Then in much later geological times the land sank, and just as the streams had deepened their channels during elevation, so now upon subsidence they commenced to fill up the bases of their channels with debris brought down from the surrounding hills. At present the Lachlan Valley at Forbes has been filled up with alluvium to the depth of several hundreds of feet. At the close of this sedimentary period the black soil plain around Forbes was at least from 20 to 25 feet deeper than it is at present. At first sight it would appear that a slight rise of the land had taken place after the deposition of the alluvium, and by this means that the streams again had grown somewhat stronger, and that the upper portion of the alluvium had been cut away, leaving only isolated patches, terraces, and broad slopes of alluvium to indicate its former great extent. A simpler explanation, however, is to be found—namely, that the plains were rapidly formed after the formation of the plateau. After the formation of the gorges in the plateau, the streams lost their former strength; hence they now carry along smaller loads, and the old plain is at the present time being cut up by the rivers which formed it.

Prospecting operations show that a fairly coarse drift is often found along the base of the gutters of the leads, while much of the surface material is of stiff black clay; they reveal the fact also that a thick drift occurs (see bore sections, page 36) about 40 feet below the surface at Forbes, and that boulders

and pebbles are scattered throughout the clay and sand layers. A more detailed description of these deposits will be found in the general chapter of the leads.

As for the age of the valley levels and the later alluvium which occupies the bases of the valleys, it can only be surmised by analogy. Valleys in other parts of the world equally large and as far removed from the sea as the Lachlan at Forbes are referable in age to the Pliocene or latest division of the tertiary, while alluvial plains similar to those of the "Black-soil" Plain are referable to the Pleistocene or Recent Period. No certain fossil evidence of age for the lower alluvium exists, but leads at Victoria (such as those of Chiltern) having the same physiographical associations have been proved to be of Pleistocene age. It has therefore been considered advisable to class the deep leads of Parkes and Forbes as of this age. On the other hand the great and apparently uniform layers of coarse drift occurring at a depth of about 40 feet below the present alluvial surface suggests a great revolution in the surrounding topography, whereby layers of sand and clay could suddenly give place to heavy drift layers. The great Black-soil Plain itself, however, for the upper 40 feet of its mass, is decidedly of Pleistocene age; bones of gigantic animals such as the *Diprotodon* having been found in the upper layers. Thus, at a depth of 18 feet below the present surface, Mr. Hasmer, of Forbes, found these interesting remains in his large brick pit. Associated with them were several "blackfellows' ovens."

VI.—GENERAL GEOLOGY.

A.—SEDIMENTARY ROCKS.

The sediments of the Forbes and Parkes districts may be classed provisionally as: Ordovician, Silurian, Devonian, and Pleistocene. Rocks of definite Silurian age occur at Forbes, while the sediments of the associated gold belt appear to be much more highly altered than those of Silurian age. A pre-Silurian or Ordovician age has thus been provisionally assigned to them. In support of this conclusion, the fact may be mentioned that rocks of similar lithological characteristics situated along the same strike as the Forbes-Parkes gold belt occur some little distance to the north at Tomingley, the age of the latter being Ordovician.

Certain quartzite, sandstone and shale beds containing *Lepidodendra* and other plant remains, as well as fish scales, have been described which are of Devonian age. The "Black-soil" Plains are here referred to the Pleistocene period.

Very little definite information has been obtained concerning the rocks of the district. They occur as inliers sporadically distributed throughout a sea of alluvium, and the outcrops of the rocks themselves are frequently cloaked over with thick waste sheets. The literature also of the general geology of the Forbes-Parkes district is very scanty. In 1885* Mr. C. S. Wilkinson made the following brief note on the sedimentary rocks of Parkes and Forbes, while on a short trip to the western district:—"The road then crosses the source of the Billabong Creek, about 18 miles from Parkes, where crop out purple fine-grained micaceous sandstones, dipping N.E. at 15°. In the next 2 miles a range is crossed composed of purple and white

* Ann. Rept. Dept. Mines N. S. Wales for 1885, p. 127.

false-bedded sandstones and soft grey shales, dipping easterly at 10° and ripple-marked; a thickness of about 400 feet of these rocks is seen in section in the road cuttings. From their lithological character they appear to be of Devonian age. At $8\frac{1}{2}$ miles east of Parkes we leave them and come upon Silurian rocks traversed by quartz reefs; in the former quartz reefs seldom seen. The Silurian formation continues thence to Parkes, where it is intruded by the diorite dyke-mass, which extends northerly from Forbes, and in the vicinity of which the principal gold-workings occur.

"Some of the prospecting shafts on Scrubby Plains reached a depth of 161 feet, passing through yellow ferruginous and white sandy clays, pipeclay, and a little quartz-pebble drift, partly cemented with ironstone and containing colours of gold; the bed-rock is silurian slates with quartz veins."

(a) *Ordovician (?)*.

The belt of sediments here provisionally classed as Ordovician has been traced northwards from the Lachlan River banks (about 2 miles south of the post office at Forbes) to the divide between the Bogan River and the Billabong Creek waters, a distance of about 32 miles. It is more than probable that the belt extends considerably farther to the north, but the present geological survey of the Forbes-Parkes gold-field has not been carried beyond this point. To the south it passes under the Lachlan River alluvium; eastwards it is bounded in great measure by the alluvium and the Devonian rocks; while quite close to the township and to the Lachlan Reefs the Silurian sediments are separated from the rocks under consideration by a narrow belt of alluvium. The strike of the sediments varies from north and south to north 15° east and south 15° west. The dip is variable, the rocks of the system having been strongly folded. The sediments themselves consist of breccias, tuffs, arenaceous clayshales, slates, carbonaceous slates and limestones, which have been highly altered. The alteration is more emphasised along certain lines than along others; nevertheless the zones of alteration always coincide with the general strike of the gold belt. The limestones, which contain encrinite stems, have been converted to marble with a development of a schistose structure in places. Shales have been converted into slates, into phyllites, and even into schists in places, as at the Aldrich Trig. Station. A strong cleavage has been induced in these rocks, the traces of the bedding planes having practically disappeared. The breccias, along certain lines, have had augen-structures developed within them, while in others the individual fragments of the breccias have been drawn out into fine films of carbonaceous material, examples of such action occurring all along the line of the Lachlan Reef workings. In other places the coarser sediments underlying or overlying finer and weaker sediments have been folded steeply, with the production later of saddle-reefs, the latter class of structure being illustrated by the Magpie and Staples Reefs, which occur about 9 miles north of Forbes. The jasperoid and cherty claystones form stronger structures; in them details of crumpling are well seen; on the other hand, however, there are minor variations only in their lines of strike, one of the belts persisting in a direction about 10 degrees east of north for a distance exceeding 20 miles. Eastwards this pre-Silurian series presents a strong unconformity with the overlaying Devonian.

These sediments, again, have been intruded by andesite dykes, and moreover they contain numerous auriferous veins, which are associated with intrusive andesites. Westward, however, of this intrusive belt, occur certain lines of internal crushing, and such are often occupied by lenticular masses of auriferous material.

Certain belts of crushed rock contain much calcareous material which appears to have been drawn in part to the surface and there deposited by evaporation to form long lines of calcareous tufa, commonly regarded as limestone beds. It appears to be a product mainly due to the action of great solar heat in drawing material in solution to the surface, and there depositing it because of semi-arid conditions.

It has been mentioned previously that no fossils have been found in this series whereby their age might be ascertained. Moreover, the rocks of definite Silurian age to the west reveal no junctions with the mass of sediments under consideration, whereby the relations between the two systems might be understood. Nevertheless the evidence available points to a pre-Silurian, probably an Ordovician age, for these sediments. For it may be mentioned that the neighbouring Silurian sediments, although possessing a similar strike, yet have not been folded sharply like those of the gold belt. Neither do they possess zones of crushing. In the second place the Silurian sediments are not cleaved, neither have their bedding planes been obliterated to any considerable extent. Furthermore the Silurian series contains no gold veins, while the other series is full of them. Furthermore, the peculiar andesite intrusions connected with the gold veins are not represented in the adjoining series. Another point of interest may here be mentioned as bearing on this question of relative ages. In Parish Currajong certain un-cleaved rocks have a north and south strike. With these are associated ordinary limestones and marbles. Immediately, however, to the east occur the rocks of the gold-belt, such as altered limestones, schistose slates, having a strike of north-north-east and south-south-west.

Ordovician rocks are not absent from the district, for at Tomingley graptolites of this age have been recorded by Mr. W. S. Dun* from collections made by Messrs. Danvers Power and Card in 1898. The graptolites were first discovered by Mr. F. Danvers Power at the Myall Reefs, Tomingley, in 1897.† The specimens described are *Chinacograptus* and *Dicellograptus*.

Mr. R. H. Cambage also found graptolites in this locality during the year 1899. These graptolites were subsequently described by Dr. T. S. Hall as *Dicellograptus*, cf. *elegans*, Carr.; *Diplograptus Carnei*, T. S. Hall; *D. foliaceus*, Murch.; *D. cf. Whitfieldi*, J. Hall; *Climacograptus tubuliferus*, Lapw.; *C.*, spp. ind., *Dictyonema*, *Callograptus* cf. *Salteri*, J. Hall; and *Dendrograptus*.‡

Tomingley lies about 60 miles north of Forbes, and the line of strike of the gold belt here considered, as mapped between Forbes and Alectown, would pass close to Tomingley if continued to the north. In addition to this the lithological characters appear to be somewhat similar in both districts. Thus Mr. Dun, in his description of the Tomingley graptolites, mentions their occurrence in "a bluish-gray lustrous slate." This description would answer that of many of the slates of the gold belt under consideration.

If this large area of rocks stretching from the Lachlan River south of Forbes to Tomingley be of Ordovician age, as it appears to be from the evidence here presented, then the outcrops of rocks of this age in New South Wales is not of such rare occurrence as had been believed until quite recently. Up till 1896 rocks of this age had not been recognized in New South Wales. In that year Mr. J. E. Carne, Assistant-Government Geologist, while conducting a prospecting expedition

* The Occurrence of Graptolites in the Peak Hill District. Rec. Geol. Survey N. S. Wales, 1898, V, p. 183.

† Ann. Rep. Dept. Mines N. S. Wales for 1897, p. 291.

‡ Rec. Geol. Survey N. S. Wales, 1902, vii, pp. 49-50.

along the Victorian border, from Cape Howe to the head of the Murray River, found abundant graptolites in slates, which were determined to belong to the Ordovician period by Mr. W. S. Dun.*

Other workers since that time have discovered rocks of similar age in the southern half of the State. Thus, in 1897 and 1899 came the finds already mentioned from Tomingley.

In 1899 again Mr. E. F. Pittman, the Government Geologist, found graptolites of Ordovician age at Mandurama.† These forms were described by Dr. T. S. Hall as *Climacograptus affinis*, T. S. Hall; *Diplograptus manduramae*, T. S. Hall; and *D. sp.*‡ During the same year Mr. R. H. Cambage§ collected specimens of graptolites at Orange, also of Ordovician age.

Another discovery of Upper Ordovician graptolites was made by Mr. J. E. Carne|| on the 27th July, 1907, at Tallong, near the head of the Shoalhaven River.

The following forms were identified by Dr. T. S. Hall:—*Dicellograptus elegans*, Carr.; *D. sp.*, *Dicranograptus Nicholsoni*, Hopk.; *D. hians*, var. *apertus*, T. S. Hall; *D. cf. cyathiformis*, Elles & Wood; *D. sp. Diplograptus foliaceus*, Murch.; *D. Carnei*, T. S. Hall; *Climacograptus bicornis*, Hall; *C. sp.*, *Cryptograptus tricornis*, Carr.; *Glossograptus quadrimucronatus*, Hall.¶

Dr. W. G. Woolnough,** of Sydney University, also independently found graptolites in this series at a slightly later date.

Thickness of pre-Silurian Beds.

It was impossible at Forbes and Parkes to form even an approximate estimate of the thickness of the so-called Ordovician series. But that it is of great thickness cannot be doubted—probably as much as several miles. This is evident from the fact that the main rock belts composing the system do not appear to be duplicated within the boundaries of the area mapped, but extend for 10 miles to the east, with varying but high angles of dip.

The main sections at the end of the report illustrate the probable relation of Silurian and Ordovician (?) sediments. Fig. 1 illustrates a section across the pre-Silurian (?) rocks at Mumbidgle Trig. Station.

(b) Silurian.

Sediments of this age occur immediately to the west of Forbes, and consist of sandstones, quartzites, tuffs, conglomerates, limestones, claystones, and cherty claystones. They may be traced northwards along their strike from the banks of the Lachlan River for a distance of about 12 miles, whence they pass under the alluvium of the Billabong Creek. After crossing the black-soil plain, formed by the Billabong alluvium, in the direction of the strike of the Silurian rocks, one finds the typical Silurian sediments (developed south of the alluvium) to have been replaced in part by huge andesite flows, sills, by volcanic tuffs, shales, lenses of limestone, and by other rock types. Where definitely proved, the Silurian has a strike which almost parallels that of the associated but older sediments. It appears to be of the nature of a denuded anticline, the summit of which has been worn away,

* Ann. Rept. Dept. Mines N. S. Wales for 1896, p. 101; see also Dun, W. S. Records Geol. Survey N. S. Wales, 1897, v, pp. 124-127; Hall, T. S., *op. cit.*, 1902, vii, pp. 49, 59.

† Records Geol. Survey N. S. Wales, 1900, vii, p. 1.

‡ Records Geol. Survey N. S. Wales, 1900, vii, pp. 16, 17.

§ Journ. Roy. Soc. N. S. Wales, 1899, xxxiii, p. xli.

|| Ann. Rept. Dept. Mines N. S. Wales for 1908, p. 171.

¶ Records Geol. Survey N. S. Wales, 1909, viii, pp. 339, 340.

** Proc. Linn. Soc. N. S. Wales, 1909, xxxiv, pp. 783, 784.

leaving both limbs. The central area is a mass of crumpled and indurated claystones, and represents a plunging anticline, which at first sight suggests a pre-Silurian mass. From its general lithological characters, its lack of cleavage planes, its anticlinal structure, so closely related to the associated Silurian anticline, it has, however, been referred here to the Silurian period.

A curious point concerning the junction of the Silurian and the pre-Silurian in the Forbes-Parkes District may be here mentioned. It has been already mentioned that the Silurian rocks are neither cleaved nor much crumpled, while the sediments to the immediate east have been intensely cleaved, crumpled, and intersected with numerous andesites and gold veins. Nevertheless, as the Silurian series is traversed from the core of the anticline towards the gold belt, the dip increases, but always is inclined to the older gold belt, until at a point near the contact it dips against the belt at an angle varying from 55° to 75° . Beyond this series of observed dips, the surface is cloaked with a waste sheet. It is quite possible that this dipping of a younger against an older mass has been occasioned by an overthrust fault, and this interpretation has been adopted in the appended section, illustrating the structure of the field.

Fossils.—Forms of life, of undoubted Silurian age, occur throughout the series. The determinations of these are by Mr. W. S. Dun.

| *Fossils from Eastern Limb of Anticline.* |

1. Parish Forbes, county Ashburnham, R. 38,699, near por. 335.
Favosites, sp. nov. (small corallite type).
Stromatoporoid, indet.
2. Parish Forbes, Quarry S. of por. 306, $3\frac{1}{4}$ miles from Forbes.
Zaphrentoid coral, cast (*Petraia* ?)
Tryplasma.
Cyathophyllum, cf. *Shearsbyi*, Eth. fil.
Favosites.
Heliolites.
 Encrinurite, stem ossicles.
 Cystoid (?) (impression of plate).
Leptaena rhomboidalis, Wilck., var.
Orthothetes Shearsbyi, Dun.
Pentamerus.
Encrinurus.
Phacops.
Hausmannia meridianus, var. nov.
3. Parish Forbes, near Forbes, Burrawang-road, T.S.R., near W. boundary of por. 1262.
Pterinea, sp. nov.
4. Parish Mumbidgle, county Ashburnham, por. 77.
Tryplasma, cf. *vermiformis*, Eth. fil.
 „ *liliiformis*, var. nov.
Cyathophyllum.
Favosites.
Pachypora.
Syringopora.
Halysites.
Heliolites.
 Encrinurite, stem ossicles.

From Centre of Anticline.

5. Parish Bocobidgle, county Ashburnham, por. 71.

Favosites.

Heliolites.

Plasma pora, Sp. nov.

From Western Limb of Anticline.

6. Parish Bocobidgle, county Ashburnham, por. 119, near S. boundary, *Halysites Australis*, Eth. fil.
 7. Parish Bocobidgle, county Ashburnham, por. 75, *Heliolites*.
 8. Parish Bocobidgle, county Ashburnham, por. 112, *Tryplasma Heliolites*.
 9. For Devonian (?) fossils, see page 25.

Sandstones, Quartzites and Tuffs.—These form a long low ridge, stretching from the Lachlan River at a point about a mile and a half west of Forbes right through parishes Forbes and Mumbidgle, and in part through parish Martin. To the south the series is distinctly tuffaceous, forming hard bluish-grey layers much prized for road metal by reason of its calcareous content. Thin beds of coarse and fine-grained sandstones and quartzites are interbedded with the arenaceous tuffs, while manganese stains and secretions are common. Some of the characteristic fossils of Forbes have been obtained from this belt and its associated lenses of limestone. As one goes north along this series, the tuffaceous element is less pronounced, and the quartzitic and sandstone characters become more pronounced. At the same time the fossil contents have been reduced almost to zero, and the dip has increased in value from 55° east to about 70° east.

Limestones.—These may be divided into two classes, the fossiliferous and non-fossiliferous.

Of these, the latter consists of well-bedded masses of an impure grey calcareous type, useless for purposes of limemaking.

The fossiliferous variety is generally dark in colour, lenticular in shape, and full of fossil fragments, particularly brachiopods and corals. This limestone is much sought after by limeburners, and some of the rock lenses have been completely removed by them. One patch well-known to the burners because of its dense fossil contents has been converted altogether into lime, and the cause of palæontology has suffered somewhat in consequence.

Conglomerates.—These appear only as isolated patches at the surface in the Forbes-Parkes district, nevertheless the patches are doubtless fairly continuous below the surface. Much information is to be gained from a study of them. At times they are coarse in texture and occur as large lenses, the individual pebbles and boulders being composed of diorite, granite, porphyries, quartzites, jasperoids, and other rock types not to be found in the district to-day. Patches of old coral reefs form lenses among them, and limestone and strong coral fragments frequently form a cement in the conglomerate pebbles. *Cyathophyllum* and *Halysites* are to be found in this cementing limestone. At other times the cementing material is composed of tuffaceous material, in which are to be seen bright crystals of ferro-magnesian material. The conglomerates on the western side of the anticline of Silurian sediments are thicker but of finer material than those to be found to

Sketch section across Mumbidgle Trig. Station.

E.

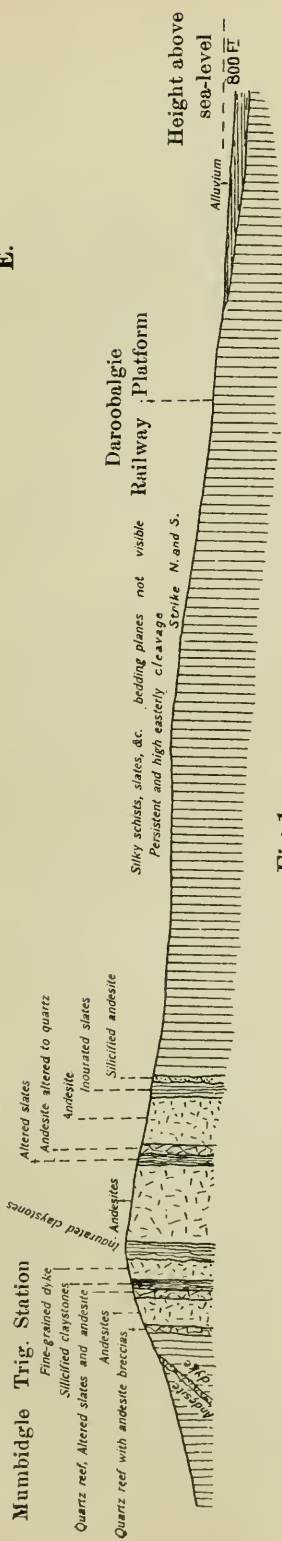


Fig. 1.

Section across Quarry for road metal near Cemetery, at Forbes

Section normal to strike

Dip 55° E.S.E.

Abundant Marine Silurian Fossils

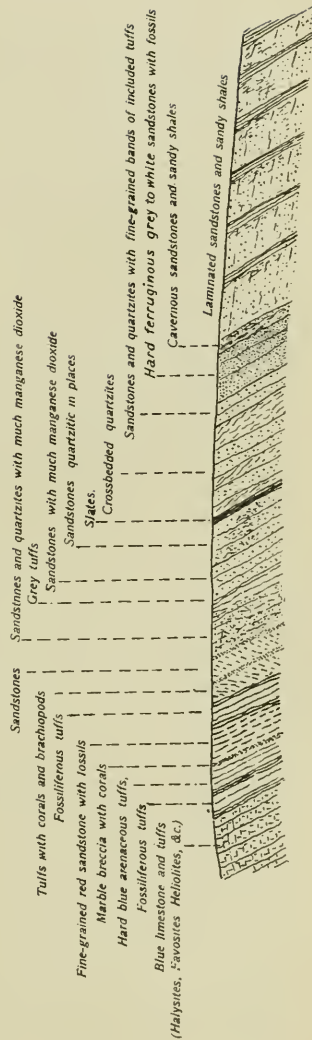


Fig. 2.

the east. Quartz and siliceous material predominate in the western pebble masses, and they show affinities with certain pre-Silurian sediments of the area under discussion. It may here be mentioned that there is an element of uncertainty with regard to the age of some of the conglomerate patches to the west. Some of them appear to be bedded decidedly with undoubted fossiliferous limestone and tuffs of Silurian age, while similar masses occur immediately under sandstones, possibly belonging to the marine Devonian beds. These will receive attention when discussing the Devonian rocks.

About a mile and a half north-west of Forbes a patch of river-drift occurs near the site of the old Cemetery Reserve. The pebbles in this drift do not appear to be of rocks occurring in situ in the district, and they doubtless have been derived from the Silurian conglomerates, whose line of strike is close by.

The first idea suggested by the sight of this massive conglomerate is that it is basal. The fossil evidence, however, shows that it is not so. Moreover, instances of the occurrence of heavy conglomerate series in the middle of a system are not uncommon, for example, the massive examples from the Permo-Carboniferous of New South Wales.

Claystones.—These are referred to on the map as the Cotton Series, from the fact that the Cotton Trig. Station is built on the highest point of a long ridge of these beds. They are in the form of indurated and laminated claystones, grey to yellowish-brown in colour. They are also very tough in nature, and thus form long lines of hills. Another point of difference existing between these sediments and the associated cherty claystones lies in the fact that the latter break into numerous small hard fragments of lozenge shape, which produce a crunching sound when walked upon, while the claystones split into long flat tabular pieces.

Indurated and Cherty Claystones.—In these the indurating element is mainly silica and lime, the texture is fine, and the joint systems are closely set together. The bedding planes are also not widely separated.

Fig. 2 illustrates a detail of the Silurian section. The main sections at the end of the report illustrate the supposed relation of the Silurian sediments and the Gold Belt.

Devonian.

Immediately above the limestones of the western limb of the Silurian sediments, a doubtful junction of the Silurian and Devonian systems may be seen. This junction is represented by a dotted line in the accompanying map, passing through parishes Bocobidgle and Mumbidgle. In the limestones characteristic fossils of the Silurian occur, namely, *Halysites*, *Heliolites*, *Tryplasma*, *Favosites*, and others, while in the massive sandstones immediately overlying them, the fragmentary and unsatisfactory fossil evidence rather favours a Devonian than a Silurian age for the younger beds. It must be remembered, however, as Mr. Dun, the Government Palæontologist, points out, that the fossils on which this tentative classification is based in no single case are either perfect or of really distinctive types. They consist of poorly preserved specimens of:—

- (a) *Rhynchonella*, *Pterinea*, *Pleurotomarioid*, parish Bocobidgle, por. 112,
- (b) *Pterinea*, sp. nov., parish Bocobidgle, por. 145.
- (c) *Orthis*, parish Bocobidgle, por. 153.

The matrix consists of massive and coarse siliceous marine sandstone and arenaceous or tuffaceous shales. The strike is generally parallel to that of the underlying Silurian, nevertheless bending slightly towards the west when traced northwards. These sandstones, moreover, appear to be conformably bedded with the associated Silurian, each being inclined at a low angle to the west.

West of this strong sandstone ridge a broad plain of alluvium is entered upon, which ends abruptly against a long high ridge of quartzites and sandstones, possessing a dip to the west, and which varies in amount from 10° to 15° . The ridge attains a general height of 500 feet above the plain, it is rarely half a mile in width, and it is notched with deep gaps whose bases are occupied by alluvium and through which the larger watercourses of the district flow in their passage west to the "Black-soil" plain which spreads out immediately after passing through the small gaps in the narrow quartzite range. The quartzite ridge simply represents the survival of a hard and gently-dipping belt of rocks, the weaker associated members of which have been denuded and buried under recent alluvium. Plant remains have also been found in these beds, the following determinations of them having been made by Mr. W. S. Dun:—

- (a) Parish Jemalong, county Forbes, Jemalong Range, "Jemalong Gap."
Archaeocalamites (?)
Lepidodendron australe, McCoy.
- (b) Parish Carrawabbity, county Ashburnham, Carradgery Range, near Jemalong Gap.
Calamitoid remains.

From the Jemalong Gap also, in this belt of rocks, a dermal plate of an *Asterolepid* fish, apparently a new species, and preserved as an impression in a coarse-grained Devonian sandstone was collected by Mr. R. H. Cambage,* the Chief Mining Surveyor.

On account both of these fossil remains and the lithological characters of the sediments themselves the series has been referred to the Upper Devonian.

If attention is directed to the high ranges east of Parkes which are composed partly of granite and partly of quartzites, sandstones, and shales, overlying flinty and cherry claystones it will be seen that the overlying quartzites dip easterly at an angle not exceeding 10° while the underlying rocks dip westerly at angles varying from 45° to 80° . Two sketch sections taken among the foothills alongside the Parkes Waterworks are here reproduced so as to show the general relations existing between the granite, the claystones, and the quartzites. Associated with the younger rocks, but lying still farther east, are bands of brown, greenish, and grey shales. Associated with this basal layer of coarse and gritty sandstones are great masses of alternating sandstones, quartzites, and chocolate shales, totalling more than 5,000 feet in places.

The basal beds of the sandstones are coarse and gritty, while the overlying quartzites are finer in texture. No fossils, with the exception of *Lepidodendron* remains, have been found in this locality, but the series is here referred provisionally to the Upper Devonian for the following reasons:—

- (1.) The lithological characters of the rocks are similar to those described by Mr. C. A. Süßmilch † for a group of sediments west of the Canobolas Mountains at Orange, and from which fossils of definite Devonian age have been obtained by the same observer.

* Ann. Rept. Dept. Mines N. S. Wales for 1892, p. 207.

† Journ. R. Soc. N. S. Wales, 1906, XI, pp. 130-141.

- (2.) A set of fish scales, apparently of Devonian age, has been found by Mr. J. E. Carne, Assistant Government Geologist, from the Harvey Range a little north of the area under consideration, and in rocks which appear to be continuous with those surrounding the Parkes water supply area.

Viewed thus the Devonian appears to have formed a gently-arched dome over the Forbes-Parkes district, the dome from Jemalong Gap to the Parkes waterworks being about 30 miles across. The upper portion of the mass has been greatly denuded, and survives now only in several ridges possessing gentle dips.

Tertiary.—No sediments of Tertiary age occur in the district under consideration, but the broad valley of the Lachlan River has evidently been excavated in Pliocene time. This idea is based on the analogy of work known to have been accomplished both in Australia and in foreign countries by rivers in Pliocene time. The sediments of Pliocene age evidently lie still farther to the west under the "Black-soil" plains.

Pleistocene.—To this period may be assigned the leads and the alluvial plains of the district. No fossils have as yet been named from the leads, and the evidence for this assigned age is physiographic. The former greater extension of the alluvial plains is shown by the denuded terraces and islands of black soil and sand which occur at heights of from 20 to 30 feet above the present level of the plains. The Harvey and Bumberry Ranges, which form the great eastern wall to the Coohang and Bogan Rivers, appear to be an upfaulted block of Pleistocene age.

Under the alluvium in Mr. Hasemer's brickpit at Forbes, and at a depth of 18 feet below the surface, *Diprotodon* bones have been found in association with aboriginal ovens. Mr. Warden Sharpe also forwarded *Diprotodon* bones from the Parkes alluvium.

B. IGNEOUS ROCKS.

These may be grouped as follows:—

(a) *Granites* of Middle Palaeozoic age.

(b) *Contemporaneous lava flows.*

- i. Andesites with cryptocrystalline bases, and amygdaloidal in places.
- ii. Banded andesites of Parkes.

(c) *Intrusive andesites.*

- i. Andesites of the gold belt.
- ii. Compact andesites east of the Gold Belt.
- iii. Massive andesites west of the Gold Belt.

(a) *Granites.*

Rocks of this type are not indicated on the map. Eastwards of Forbes, however, they have a great development, extending at least from Eugowra to the site of the Parkes waterworks. Doubtless they extend also still farther to the north. The general relations of these plutonics and the associated sediments are shown in the sections taken across the country (Fig. 3). As shown by such sections, the granite is overlain by rocks whose age is Devonian, while the igneous rock in turn apparently intrudes the pre Silurian sediments.

The rock is of acid type, and in texture it varies from coarsely-granular to micrographic, miarolitic, and finely-grained mixtures of quartz and felspar, in which are present thin flakes of a variety of dark mica. Frequently the rock possesses a reddish colour, and weathers out as large ellipsoidal blocks and tors, while at other times it breaks down into cavernous and friable masses.

If the old series of rocks associated with it are indeed Ordovician, then it is very probable that the granites briefly described here were injected into the earth's crust during the period of decided mountain-making which closed the Ordovician in this region.

(b) *Lava flows.*

i. Andesites with stony bases.

The Andesites with glassy bases, of parishes Parkes, Currajong, and Goobang, form a peculiar group. If one follows the line of intrusive andesites with which the Nibbler's, Koh-i-noor, Buchanan, Bonnie Dundee, Bushman, and Dayspring mines are associated, one comes to a vesicular basalt near the Currajong Public School, which passes immediately to the north into andesites with fine-grained bases.

In parish Goobang, the mass formed by them is about 5 or 6 miles in length, and from 2 to 3 miles in width. (See general map.) Gold is reported therefrom in small quantities, as, for example, at the back of the Parkes Trigonometrical Station on Nash's Hill; but it is doubtful whether gold in payable quantities is associated with the rock, unless, perchance, at spots where it may have been intruded by later andesites in turn, or at spots where zones of crushing have been developed. Associated with the mass under consideration are coarse breccias, or inclusions of basic augitic andesites.

In these pages the rock has been classed as a lava flow contemporaneous with the associated sediments. On the other hand, in the vicinity of the rifle butts at Parkes, it appears locally to have an intrusive origin. The glassy appearance of the base is not a sure proof of its extrusive nature even when occurring in such great masses as that just described, but coupled with the vesicular nature of the rock in places, it is a legitimate conclusion that the rock is of eruptive nature.

The following petrological notes on this rock have been supplied by Mr. G. W. Card, Curator of the Mining Museum. The numbers supplied in these petrological descriptions are those in the Catalogue of Rocks in the Mining Museum:—

No. 7641. portion 15, parish Goobang, county Ashburnham.—Hand specimens of this rock are jointed and possess a horny texture and a sub-even fracture; greenish-blue weathering, also red and brown, with pitted surface.

Under the Microscope.—Comparatively fresh augite is revealed in an isotropic yellowish base. Much secondary silica is present; felspar is barely recognisable as such, as its traces are almost obliterated.

In other specimens an amygdaloidal or vesicular structure is present. Traces of epidote also occur.

ii. Banded Andesites of Parkes.

These are of dull-green to grey colours and occupy a long north and south belt extending from the Billabong Creek, near Tichborne, to a point several miles north of Parkes. The extent of the occurrence may be seen by a

reference to the general map in parishes Parkes and Currajong, and the boundaries are shown by dotted lines because of the impossibility of mapping them accurately. No two independent observers would decide upon the same boundaries. One reason for this is the fact that with this series of andesites are associated thin lines of slates, chloritic schists, tuffs and cherty clay-stones; these bands being very narrow and their outcrops being almost negligible in area they have been included with the associated andesites. Furthermore, owing to the lack of rock outcrops the eastern and western boundaries of the andesitic belt could not be determined with any amount of precision. Such outcrops as were seen form low hills whose longer axes lie in a north and south direction and give rise to the impression that one is looking at rows of slates standing on edge. This suggestion of steeply-dipping or cleaved sediments is strikingly apparent. Only upon closer examination are the rocks seen to be porphyritic lavas with a well developed flow structure. The surfaces due to parting along lines of flow are rough and platy, and the fracture across these planes is very uneven and hackly. Zones of strong crushing are arranged parallel to the strike of the lavas, and gold deposits have been developed in such zones of stress. Several leads also head in this andesite belt. The auriferous quartz veins of this belt are at times lenticular in shape, and frequently the external surfaces of the quartz lenses curve sympathetically with the associated flow surfaces of the andesite. At other places in this andesite mass the quartz veins are more of the nature of a stock-work.

The soil derived from the weathering of these rocks is reddish to brownish-red in colour. Mr. Card's description of a rock from this belt is as follows:—

No. 7647. Locality T.S.R. 16,016, parish Currajong.—Colour dull-green, platy. Hackly fracture across fissility. Small felspar phenocrysts weathering out in relief.

Under Microscope.—Platy structure due to parting along lines of flow indicated by felspar microlites. Plagioclase phenocrysts calcified in part. These lie to some extent across the lines of flow; twinning not obliterated but rather obscure. Magnetite plentiful.

(c) *Intrusive Andesites.*

With the belt of sediments provisionally assigned in these pages to the Ordovician, a great number of lines and lenses of andesite are associated. These are shown on the map in the parishes of Parkes, Currajong, Goobang, Goonumbla and Dowling.

In the field they appear as long rib-like or lenticular masses rising out of the plain of alluvium or waste, inasmuch as they represent the survivals of the more durable rocks of the district, the associated sedimentary rocks having been removed or buried beneath the cloak of waste which forms the greater portion of the superficial geology. Thus the relations of the sedimentary beds and these igneous masses are obscured. For this reason also the following description of the andesites is not at all complete:—

i. Andesites of the Gold Belt.

Under this title are included an interesting group of rocks which occur as dykes and sills throughout the greater part of the distance extending from the Britannia Mine, south of Forbes, to the Dayspring Mine, situated about two miles north of Parkes. Northward of the latter

mine the andesites under consideration appear to give place to an andesite which on first appearance appears to contain a glassy base. The belt is exceedingly narrow, as may be seen by a reference to the map. The bulk of the important gold reefs, such, for example, as the Britannia, the Lachlan, the Koh-i-noor, the Buchanan, the Bushman, and the Dayspring, are intimately related to this intrusive line, and appear in some way to depend not only on the dykes and sills under consideration for their gold values, but on them also for their very existence. Nevertheless, in the vicinity of many of the reefs the andesite itself may be seen to have been intensely altered by the auriferous solutions themselves, thus showing that the andesites must have consolidated before the ore entries had been effected, and that the fissures developed both alongside of, and across, the igneous rocks had formed guiding lines for the hot wandering solutions. In many cases the andesite has been almost completely altered to impure quartz in this process. At its junctions with the associated sediments large impure quartz veins and breccias frequently occur. Such breccias have arisen generally in the first place by a fine shattering action among the country rocks, and in the second place to a subsequent percolation of them by siliceous solutions. By this means the quartz gradually ate away the walls of the tiny cracks and replaced the country, whether of sedimentary or igneous origin, by impure quartz. Frequently this replacement action was not complete. Brecciated appearances have thus originated. In texture the rock varies remarkably. Thus, in some mines, the same rock has been described as belonging to two distinct types—namely, diorite and felsite.

The age of this rock type is unknown, but it is absent from the neighbouring Silurian. The gold veins also are absent from the latter formation. The intrusive andesites thus may be pre-Silurian in age.

The following petrological notes are based upon the examinations by Mr. Card of rocks, whose catalogued numbers are:—7598, 7601, 7602, 7603, 7604, 7607, 7608, 7654, 7655 and 7664.

Macroscopic.—Rocks commonly compact, pale green, greenish grey, uneven to sub-even fracture, frequently jointed, possessing abundant felspar phenocrysts, sometimes exceeding one quarter of an inch in length, with hornblende and augite phenocrysts also. The felspars are frequently clouded and twinning is obscured. Chlorite and calcite are commonly seen in the ground mass.

Microscopic.—The felspars at times are comparatively fresh, the ferro-magnesian minerals are often highly altered. Secondary minerals are frequently developed, such as chlorite and magnetite. Apatite is present as conspicuous crystals in the ground mass. The ground mass itself is frequently massive, granular, or microcrystalline. The types are rarely dioritic, and almost in every case andesitic.

ii. Compact andesities east of the gold belt.

The occurrences are lenticular patches and long lines of low hills in parish Dowling. Mapping of these andesite masses was difficult, owing to the great amount of alluvium present. At times they have the appearance of light coloured basalts, at others of indurated and flinty sediments. Their relations to the associated sedimentary formations are not known. They are here classed as intrusives.

iii. Massive andesites west of the gold belt.

Rocks answering to this description occur as very long lines, sometimes attaining a width of a mile. The associated rocks are limestones and indurated shales. Of these associates the former are rarely visible, being covered by a cloak of waste and alluvium. Although altered at times to an impure marble, they do not appear to have any developments of idocrase, garnets, or similar minerals within them, such as one might expect from their proximity to masses of basic andesite a mile in width, provided that the latter be of intrusive nature. Near the junctions of the igneous masses with the associated sediments, however, one finds at times large masses of siliceous and ferruginous material suggestive of the action of hot water on sediments, and this would favour the assumption of an intrusive origin for these rocks. Included masses of angular, rounded, and ellipsoidal fragments of more acid and more basic igneous rocks are of common occurrence.

Possessing only this scanty information concerning the north and south lines of andesites under discussion, it is, perhaps, advisable to assign to them an intrusive origin, the intrusions being of the nature of sills.

The following petrological notes on this group have been supplied by Mr. G. W. Card :—

Rock specimen 7637. From portion 73, parish Goonumbla. Porphyritic andesite with augite. Creamy plagioclase phenocrysts, up to half-an-inch in length, tabular in habit. The weathered surface shows an abundance of these phenocrysts standing out in relief. Lamellar structure in places is well brought out by this weathering; the fracture is even.

Under Microscope.—Much opacity is evidenced throughout by reason of alteration, but the twinning of the feldspar is still distinct. Augite is occasionally present more or less altered, and shows the development of a small amount of epidote and magnetite. Slight epidotisation has also been set up among the feldspars.

7646.—Augite andesite from Miller's Look Out, near north-east corner of portion 791, in parish Currajong.

Macroscopic Characters.—The rock is grey in colour, and contains much plagioclase, and some augite as phenocrysts. The average size of the largest of the phenocrysts is about a quarter of an inch in length. The fracture is sub-even. Weathers to a buff colour. The surface of the rock is pitted.

Microscopic Characters.—The ground mass is dense, with abundant black pigment spots. The feldspars are completely clouded, and are recognisable by their outlines only. The augite is fresh, and occurs as small automorphs. Magnetite is plentiful, both in the augite and in the ground mass. Apatite is conspicuous, both in the ground mass and in the augite.

VIII.—ECONOMIC GEOLOGY.

The minerals worked in the Forbes-Parkes district are gold and copper, but the copper deposits are so relatively unimportant that they may be neglected in this discussion.

The auriferous deposits fall naturally into three groups, namely :—

- A. The "Leads,"
- B. The quartz veins associated with the intrusive andesites.
- C. The auriferous quartz masses in "zones of crushing."

A. THE LEADS.

General Description of the Leads of Parkes and Forbes.

The gold deposits contained in these superficial and buried deposits of river drift represent concentrations, more or less payable, of gold which has been derived from the quartz reefs in the locality.

In the description of the leads, it will be advisable to deal firstly with their origin ; and secondly, both with the manner of leasing the ground and with the methods employed in working the alluvial claims.

(1) *Origin of the Forbes-Parkes Leads.*

A shallow lead may be defined as a watercourse containing alluvial deposits which are open to the sky.

A deep lead may be considered as a watercourse, whose alluvial contents are buried beneath either a capping of alluvium or lava (or both).

The leads of the Forbes-Parkes District belong to both these types ; in fact, the shallow leads frequently pass down stream into deep leads. They contain gold values, and such are frequently found :—

- (a) Along the gutters of the main channels and associated with the coarser stream deposits.
- (b) Along the rim-rock or the sides of the buried stream channels.
- (c) Among various and irregularly arranged patches of coarse stream material situated above the older and deeper buried stream channels.

In order to understand the origin of "leads" such as those of Parkes and Forbes it is necessary to have a distinct insight into the methods of stream action. In the chapter on Physical Geography it has been shown that under certain conditions which favour increased stream velocity rocks are worn away and stream channels are deepened ; that under other conditions which favour decreased velocity stream channels are filled with *debris*, because under the latter conditions the stream is unable to transport its load as a whole vertically above the same given point as before. Nevertheless the very existence of an alluviated valley implies the wearing down or transporting action of streams (or other agencies) in the neighbourhood, whereby the material now filling the down-stream channel has been obtained. The existence of coarse drift implies relatively rapid—while that of fine silt implies relatively sluggish—stream action.

Since rocks may be worn down by atmospheric and stream action it follows that the quartz veins associated with them may be broken down also and carried away to the neighbouring watercourses, although it is evident that

hard and insoluble rocks, such as quartz, may be worn down at a less rapid rate than the associated more soluble ones, and that they may therefore stand up more or less as walls or "blows" in the hilly country. This statement, however, needs qualification. Barren or "buck" quartz veins have very little mineral contents and they usually outcrop strongly because of their insolubility, while rich gold lodes often outcrop but slightly owing to their soluble mineral contents which by decomposition cause the lode material to be easily disintegrated*. But with the destruction of the vein material there will ensue the partial removal of the gold contents and the transportation of the same to the neighbouring watercourses. We say the partial removal of the gold advisedly because it is evident that various acids exist at and near the surface of the earth and these powerful agents must dissolve a percentage of the gold contents and such dissolved gold will tend to sink to lower levels in the vein provided suitable joints occur in the latter which allow of the ready seepage of waters. This subject, however, will receive more attention when the gold veins themselves are being discussed.

We are now in a position to understand the formation of the Forbes-Parkes leads. It has been ascertained by alluvial mining operations and by an examination of the surface of the district that at one period the Lachlan and Goobang Valleys were composed of a series of denuded valley floors rising one above the other the lowest one even possessing a distinct rock-bound channel practically free from alluvium. Now because the lower channels possessed steep sides and because their bases were also narrow and possessed steep slopes the steamers flowed fairly rapidly along them, and were therefore enabled to transport large pebbles along the gutters. A fairly coarse stream wash or drift would thus be expected along these gutters. Inasmuch, also, as the stones and pebbles of this wash would be those of the country associated with the veins, one would expect to find some of the gold contents of the veins present with the heavier drift along the gutter. Moreover, at this stage there would be abundant opportunities for the gold to travel along the channels for considerable distances, owing to the steep slopes possessed by these earlier channel bottoms.

Let us now suppose that the land at this stage commences to sink gradually. In this case the velocity of the stream will gradually decrease, its transporting power will be considerably lessened, and the stream channels will be gradually filled with the *débris* derived from the hills in the vicinity. If this movement of sinking be slow and continuous the whole stream channel may be gradually filled with *débris*. But since the stream power at this stage has diminished so much, the beds of material filling the channel will not now be so coarse as the material near the base. Coarse *débris* may still be found in the channel nearer to its head, but it cannot at this stage be carried as far down the channel as formerly; so that above the coarse bottom beds one will expect to find beds less coarsely textured, such as grits, sands and shales. Similarly the gold contents cannot now be carried so far down-stream as heretofore, and thus in general one will not expect to find rich gold values in the sands and silts overlying the coarse gold drifts of the gutter. Another important point may here be noted. Gold is of high specific gravity and soon falls out of the current. In general when the stream is small and its channel is of gentle slope the gold does not appear to be carried far below the vein or lode from which it has been derived. Thus if channels of this description cut across gold reefs they will be continually enriched, but the influence of such enrichment will die away rapidly with progress downstream.

* See also Stanley Hunter. Deep Leads of Victoria. Memoirs Geol. Survey Victoria, No. 7, 1909, p. 4.

As the channel becomes filled with alluvium, any reefs which may have outcropped along the channel sides and base are slowly buried, and thus it is evident that the more an auriferous tract of country is alluviated and the more rapidly it sinks so much less is the probability of obtaining gold in the drift above the channel base, because with this rapid sinking action there is associated a corresponding sluggishness of stream action and a decided burial of the outcrops of many of the gold-bearing rocks. But there may not be continuous or rapid subsidence; on the contrary, there may be a general movement of subsidence which is accompanied by intermittent elevation at the head waters of the stream. In a case such as this the channels will become filled, but during the elevations of the associated land areas masses of coarse drift will be carried down over the sand and clay layers. It may be asked what opportunities exist for finding gold in these upper channel drifts. All things being equal they will contain gold values as well as the lower drift, but usually they will not be of so payable a nature, because, in the first place, they have not the same area of auriferous rocks over which to work, and, in the second place, their channel bases are not so steep as were those on the solid rock at the bottom, and the gold in that case cannot be carried so far downstream.

There are still other points to be considered in connection with the action of streams and the distribution of gold in alluvial deposits. Thus gold values may occur not only in the gutter, but also on the rocky sides of the channel. The reason for such uneven distribution of gold is obvious. For simplicity, let us first consider the action in the gutter, or at the base of the channel. It is a fact, long since ascertained, that ordinary stream channels have been formed by streams themselves—in other words, that streams in such cases are older than their valleys, or channels. It is a fact of observation also that the stream does very little work during periods of low or ordinary water, but depends on the period of flood to do the main work of carving its channel. This is evident also from a consideration of the elements of mechanics, for the energy of a stream appears to grow as the product of the increase of its cross-section and the cube of the increase of its velocity. In flood time the cross-section of a stream frequently exceeds 100 or even 1,000 times its cross-section when in the normal or drought stage. The velocity of the stream is frequently increased six-fold, or even more, during periods of flood. On the other hand, it is evident that so soon as the flood waters subside, the heavier material will fall out of the current, and the greatest amount of such falling out of debris will be in sheltered spots opposite cutting curves in the channel, or behind projections. Thus a strong current may be cutting into a spur. This lateral action of the stream will be accompanied by a powerful eddying motion, and such action will die away in great part on the opposite and sheltered side of the stream. The strong central current sweeps the heavier gold contents past the cutting curve along with the heavier stream material, and the eddying motion tends to carry the deposits toward the opposite and downstream side of the cutting curve, where some of the material drops out of the current. The greater the flood

the greater the agitation in the vicinity of the cutting curve, and the farther from this curve and the higher above the base are the gold and alluvial deposits then carried. Rich patches of alluvial gold are thus formed. The following sketch illustrates this point. The rich auriferous flats are opposite

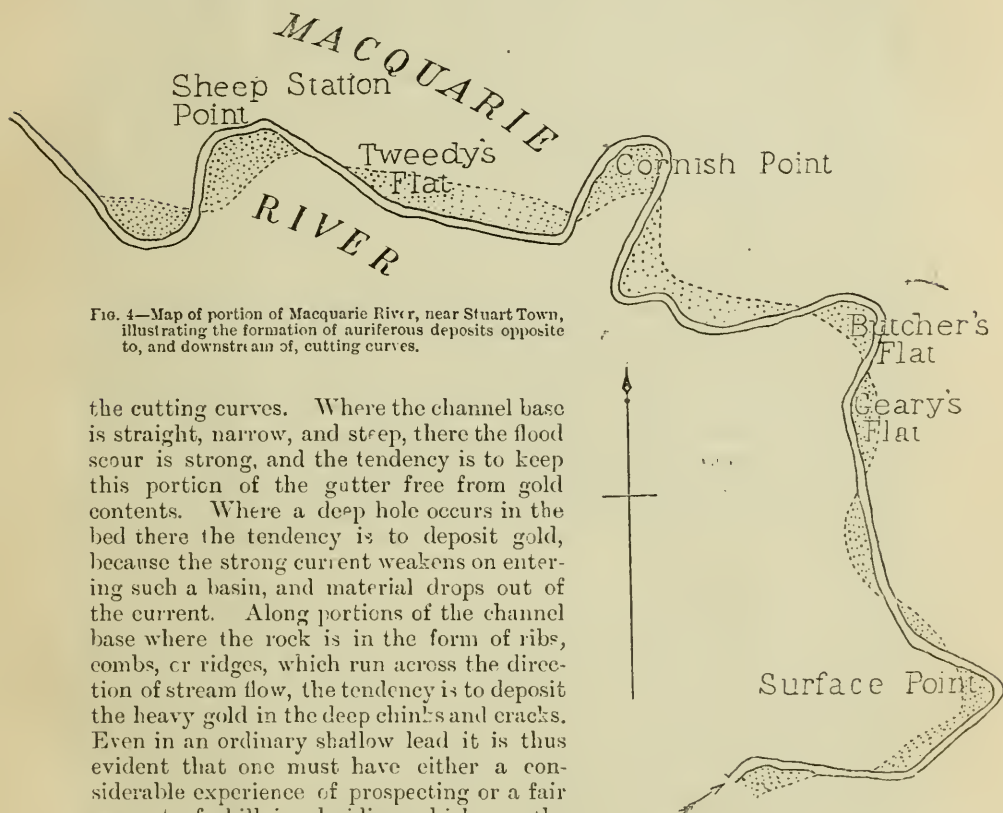


FIG. 4.—Map of portion of Macquarie River, near Stuart Town, illustrating the formation of auriferous deposits opposite to, and downstream of, cutting curves.

the cutting curves. Where the channel base is straight, narrow, and steep, there the flood scour is strong, and the tendency is to keep this portion of the gutter free from gold contents. Where a deep hole occurs in the bed there the tendency is to deposit gold, because the strong current weakens on entering such a basin, and material drops out of the current. Along portions of the channel base where the rock is in the form of ribs, combs, or ridges, which run across the direction of stream flow, the tendency is to deposit the heavy gold in the deep chinks and cracks. Even in an ordinary shallow lead it is thus evident that one must have either a considerable experience of prospecting or a fair amount of skill in deciding which are the spots likely to be the most profitable. One should know the character of the rocky surroundings so as to examine that portion of the channel base and sides which is formed of natural riffles, and one should examine all the sheltered points downstream into which floodwaters might cause the gold to be lodged. Moreover, one must ascertain whether the stream flowed formerly in a slightly different course. In such a case the form and size of the channel will help him here. For instance, in a broad shallow channel a stream may have formed a series of rich pockets of gold. Subsequently a flood may have diverted the stream to the right or to the left of its old course. The observant prospector, however, will suspect the existence of such an "older" run of gold, merely by the general appearance of the channel debris.

One is now in a position, also, to understand how gold is lodged on the "rim rock," the "high reef," or channel sides, while the channel itself is being filled with stream debris. The methods of gold deposition adopted at this stage are much the same as at the time when the gutter only was occupied by the stream. For the stream can only work in the one simple way. Its carrying power is wonderfully increased when its velocity increases,

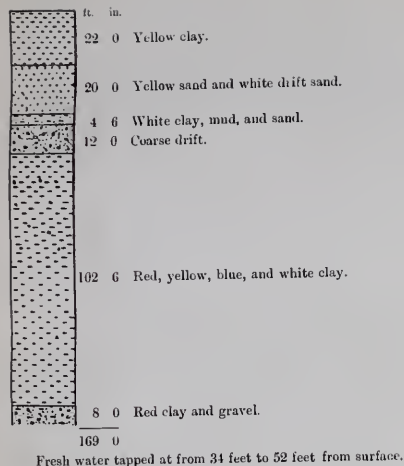
either as the result of the steepening of its basal channel slope or by increasing its volume. On the other hand, its carrying power is wonderfully decreased as the flood-waters recede. The significance of the last statement is, that at this stage the stream can move neither its heavier debris nor its coarser gold. For example, suppose that the channel has become half-filled with debris, as a result of streams dropping their loads on a sinking area. The bottom of the channel at this stage is composed of uncompacted sands, clays, or pebbles. In the case where sand and clay only are carried down there will be few or no payable gold deposits formed, because the stream strength is insufficient for the task of carrying any but the finest gold. If the stream be strong and carry coarse material during flood-time, then the gold will be deposited on the "rim rock," behind rock projections, or in spots which are relative "slacks" even during flood periods. The intervening space between the rock channel sides is so broad frequently that large amounts of wash occur, nevertheless, the stream channel is at this stage not stationary, and the gold values are so distributed throughout the drift that they are rarely valuable enough to pay the cost of mining. In this case, also there are no auriferous outcrops in the channel bottom by the disintegration of which the gutter may become replenished. Nevertheless, the side streams dump some of their gold contents near the "rim rock," or else they disseminate them throughout the wash. A very interesting point may be noted in this connection. We have seen that on such a sinking area as we have been describing the streams cannot denude their bases, but can only aggrade them. In this process the gold which once settles into the pebbles and sand at the base of the channel cannot be swept further along, but will tend to settle gradually into and along the "rim rock" and false bottoms, and there collect in pockets.

From the foregoing brief account of the formation of leads it is evident that if decided difficulties are experienced by trained prospectors in the working of shallow leads, where the workings are all more or less open to the sky, then the problem becomes much more complex when one considers the exploitation of deep leads, which consist of alluvial deposits capped by broad expanses of alluvium or lava. For in such a case not only is the area to be prospected greatly increased as compared with that of the shallow lead, but the depth also is greatly increased, and all the work of exploitation has to be done by the laborious processes of mining underground in country which is generally both wet and heavy. Another circumstance which complicates the exploitation of deep leads is that which arises when the old defined channels have been filled with debris, and the whole countryside is gradually buried under alluvium.

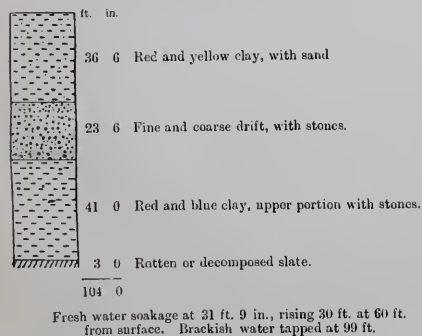
It may be interesting to note the methods adopted by the streams in covering such an area with alluvial deposits. The alluvium will overflow the stream channels or valleys first at points downstream; then the alluvial plain will continually grow in depth and width by the progressive burial of the channels and inter-channel areas upstream, much as flood-waters first occupy low-lying lands, and gradually creep higher up the surrounding slopes. As the alluvial mass overtops the old channel rims, so the streams will form fresh watercourses, and they will discharge their contents over the whole of the area of subsidence. Their channels will be ever shifting, because they possess no rock walls which can limit the movements of the streams. Where the streams leave the solid rock and pass on to the alluvium wedge shaped masses of pebbles and drift coarser than sand in texture may be expected, while farther out and also away from the stream channels clay will be

GOLD-PROSPECTING BORES, FO

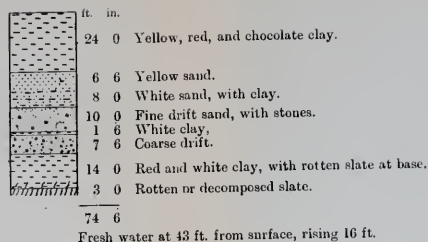
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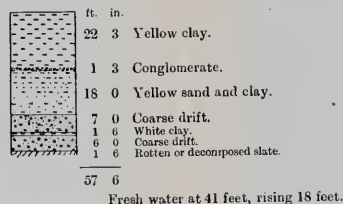
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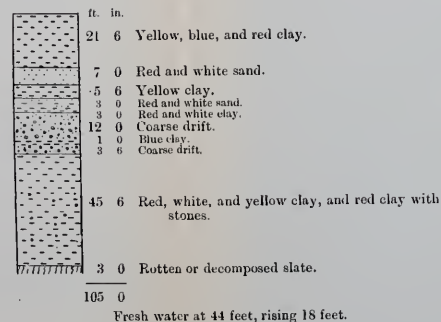
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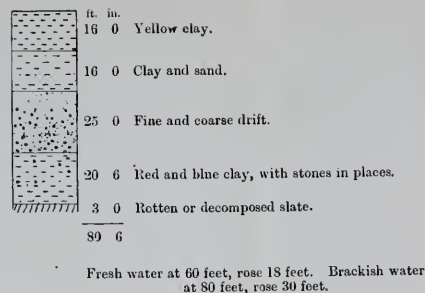
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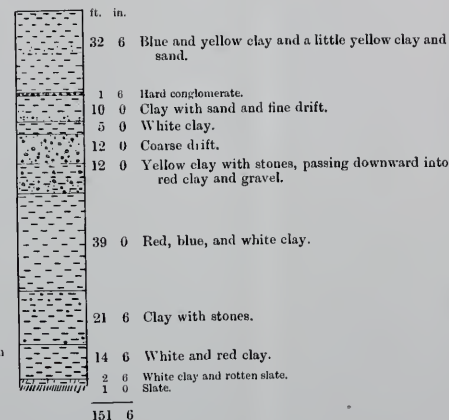
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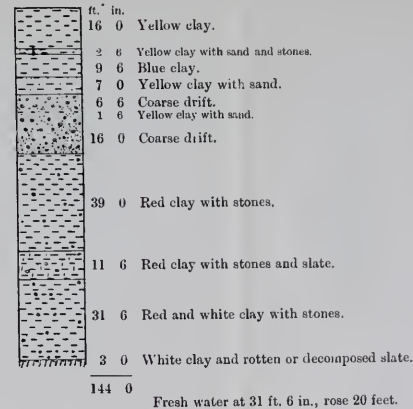
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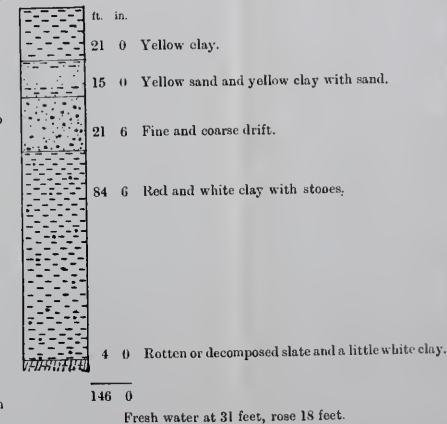
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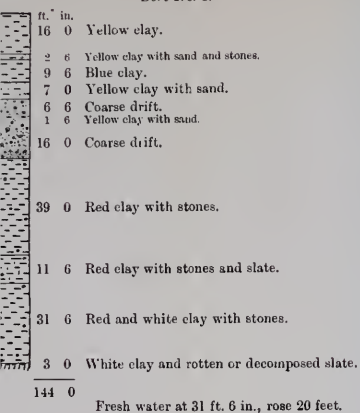


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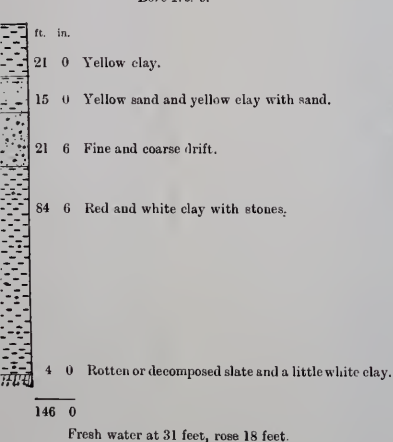


SPECTING BORES, FORBES.

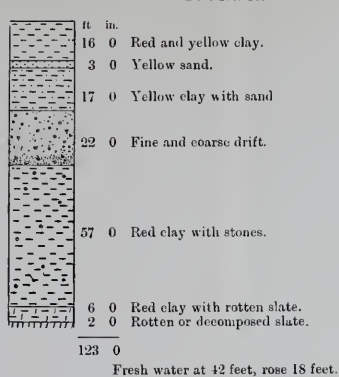
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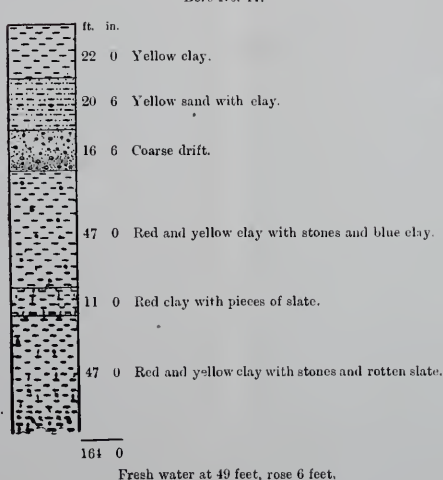
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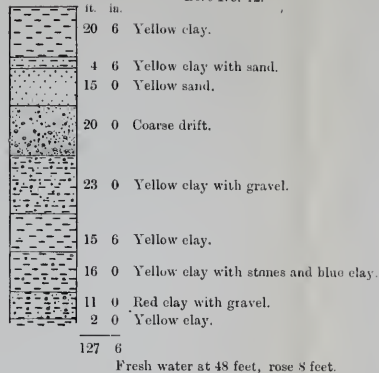
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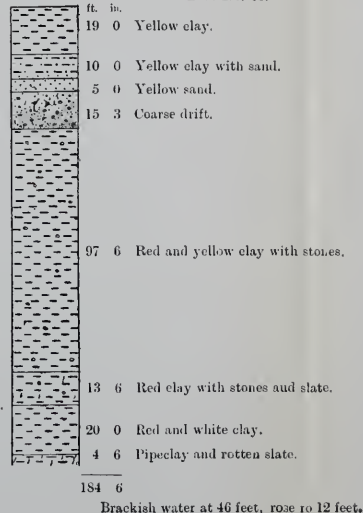
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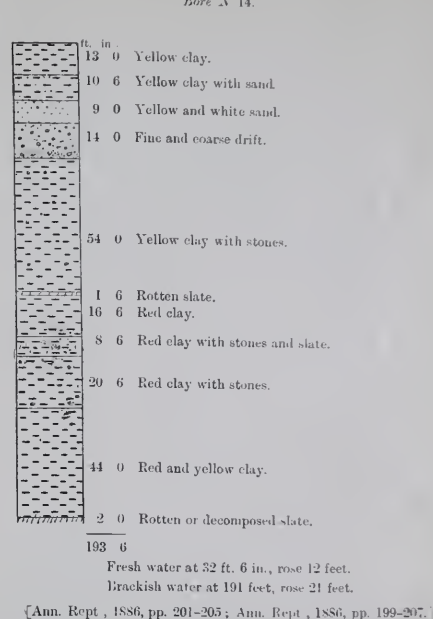
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Bore No. 14.



deposited. Hence clay, sand, and pebble masses may be dovetailed into one another. The gold contents will decrease in value in a very rapid manner once the streams pass from the rock masses to the alluvial plains, partly because of the gradual submergence of the auriferous veins themselves, and partly because of the lack of stream strength required to transport the gold for any considerable distance, and partly, also, because of the instability of the stream channels, the accumulation of gold in pockets being thus prevented. It is evident, therefore, that the bulk of the payable gold will be found along the gutters and "reef rock" of the defined channels, the gold in the body of the higher belts of drift being more finely disseminated, and needing cheaper metallurgical processes for profitable extraction than those at present in general use.

Before concluding this sketch of the origin of the Forbes-Parkes leads an interesting fact of observation may be noted. During the sinking operations at Forbes, along the Caledonian and South leads, the miners passed firstly through a mass of clay, averaging about 40 feet in depth, and secondly through a mass of drift averaging 20 feet or more in depth. Now, in attempting an explanation of such an apparently widespread phenomenon as this alternation of thick beds of coarse drifts and of clay, we must remember that the area under discussion was one of subsidence. As such the occurrence of these thick beds of pebbles overlying clays cannot be explained by assuming the visitation of the area by heavy rains. On the other hand, if the country further to the east should have been raised in the form of a plateau, then the streams would have gained so much in strength by reason of the increased slope of its channel base that deep gorges would have been formed rapidly in the hinterland, and the coarse material derived from such gorge or cañon cutting would have been spread out over the sinking area as a coarse drift or conglomerate. After the gorges had been cut some distance back into the ranges, the channel slopes would have become less pronounced, and sand and clay would then be carried down instead of pebbles.

If now the land should rise gradually after such a great plain had been formed, or if the load of material brought down by the streams should decrease, as they naturally would do, as the bases of the stream channels were cut down to more gentle slopes, then, as a result, channels would first be formed in the black-soil plain, while at a later period the plain itself would be benched back until only small patches and terraces of it would be left in positions favourably situated as regards their preservation.

We may now sum up the main facts in connection with the history of the Forbes and Parkes leads.

- (1) The land was raised and a series of "valley in valley" forms were excavated by the Lachlan tributaries. Along the steep channel bottoms gold was deposited by the rapid streams, for during the process of wearing the country down, the lodes contained therein were also broken up and their auriferous contents "were washed down and lodged in the channels of the old streams."
- (2) After the formation of these rock channels, the land sank, and the rock-bound water-courses, instead of being deepened, were at this stage gradually filled up. The gold contents became poorer in these upper alluvial deposits, firstly, because the gold reefs were being buried in part; secondly, because the streams at this stage had not the power to carry the coarser gold as far as formerly; and thirdly,

because the gold was distributed throughout a vast width of alluvial debris, instead of being concentrated near the bottom of a narrow gutter.

- (3) After the filling of the well-defined channels, the alluvium began to overflow the rock rims of these old watercourses and to bury the whole lower portion of the main Lachlan Valley. The streams at this stage ran in no well-defined channels, except locally, and gold was naturally jigged and deposited upon the channel sides and false bottoms.
- (4) The land to the east of Forbes appears to have risen considerably at this stage, and heavy masses of coarse drift were laid upon the clay and sand beds by the swiftly-flowing streams. As the strength of the streams decreased, the "black-soil" plains were deposited in turn upon the coarse drifts.
- (5) After the formation of the "black-soil" plains, the streams commenced to wear these away in turn, until now over great areas in the district under consideration, the plain has been cut away to a depth of from 20 to 25 feet. In these black-soil plains no payable gold deposits occur, because the strength of the streams which made the plains was not sufficient to carry payable gold deposits into the fine alluvium composing them.

This being the general method of the formation of such leads as those of Forbes and Parkes, one is now able to appreciate certain difficulties experienced by the miners in exploiting them. The following extract, taken from various official sources show clearly the disabilities under which the prospectors laboured. The first extract is from a report of Mr. C. S. Wilkinson,* and deals with the question of the deeper ground not being always the most payable. "Such not uncommon occurrences may have originated in various ways; for instance, at the particular time of the deposition of the gold-bearing drifts, the old stream may have been wearing away and distributing as drift some auriferous bed, rock, or quartz reef, which had no great depth, consequently when the river had eroded its channel to a lower level, the underlying rock it then acted upon may not have been auriferous, and therefore the drift derived therefrom would be so also. Again, in Silurian country, there have been frequently noticed belts of non-productive rock, running parallel and alternating with rich tracts, these then, under certain circumstances, would also afford an explanation upon the above-mentioned facts."

Mr. Warden Dalton also frequently refers to the disabilities under which the miners laboured. The following two extracts from "Mines and Mineral Statistics, 1875," illustrate the point well:—

"As the prospectors proceeded with their labours, they discovered that the depth varied, and that long ridges, some containing quartz reefs, lay concealed beneath a level surface. The miners had yet to learn that the deepest ground was not the most auriferous, and every new ridge, or as they designated it, mullock bank, created a demand for a new line. The swinging of base lines was incessant and no little confusion and litigation was the result."—(p. 31).

"At that period the miners sought exclusively for the deepest ground. . . . Shaft after shaft was sunk and the result was ever the same—wash in abundance and gold, but not payable. The miners burrowed through the deep ground until their means and energy were alike exhausted, and

* "Notes on the Geological and Mineralogical Collection at the Metropolitan Intercolonial Exhibition, 1875." [Quoted from H. Margules' *Ann. Rept. Dept. Mines N. S. Wales for 1876*, p. 84.]

many had abandoned their areas, when the holders of a claim on the line a mile from the creek, at a depth of 157 feet, bottomed upon good wash in a well-defined channel containing coarse gold. . . . At last a shaft, sunk at random 100 yards to the east of the old line, bottomed at a less depth, by about 15 feet, on the eastern side of a reef or ridge, and struck the long-sought lead”—(p. 37).

In the early days of the Forbes alluvial mining, the “gutters” only were supposed to have been worked, and repeated attempts were made at later dates to locate gold deposits which were supposed to exist upon the channel sides.

“The smallness of the claims (40 feet square, E.C.A.) prevented the application of the machinery and plant necessary to enable the holders to contend with water, quicksands, and swelling schists with any prospect of success. With imperfect appliances the miners had no thought of reef-wash or benches. . . .”—(Warden Dalton, Ann. Rept. Dept. Mines, 1877, p. 75.)

About thirteen years after the main Forbes leads had been abandoned, Mr. Phillip Davies (Ann. Rept., 1877) stated that the sides of the channels had not been exploited, and he himself commenced a vigorous prospecting campaign along the South Lead. Nevertheless, all such have proved unsuccessful; ‘reef’ gold has indeed been found, but not in payable quantities.

“Other difficulties were experienced in tracing the leads into the deeper ground. . . . “The Bushman’s Lead crosses the Goobang Creek at a depth of 93 feet, and enters a small circular lagoon about 200 yards in diameter, which is filled with wash-dirt to the thickness of from 3 to 4 feet. . . . From the lagoon, the Great Northern extends northward in a direction parallel to the course of the creek, but upstream. . . . There is much doubt as to the course of the outlet from the lagoon.”

“Proceeding farther north, we find the Welcome Lead lost in the wet and deep ground where it was most productive—the Bushman’s Lead lost in the bed of an ancient lagoon, where it was also rich in gold—McGuiggan’s South and the London Leads also lost in deep ground—and the Ben Nevis workings confined to ledges in the vicinity of the ancient bed of a river.”—(Ann. Rept., 1877, p. 76.)

The possibility of the existence of larger and deeper channels than those already known in the district has been often considered by the alluvial miner of Forbes and Parkes. The following extract from Mr. Warden Dalton’s report sums up the information on this point in the days when the values of the deep leads were rapidly decreasing:—“The richest portion of the Welcome Lead was that along the margin of the Goobang Creek. From the foot of the Welcome to the foot of the Bushman’s, following the course of the creek, is a distance of about five miles, and the deep channel between these places might be traced without encountering more than the ordinary difficulties that attend such operations. It is perfectly clear that all the most auriferous ranges and leads have been surrounded to the southward and eastward by a deep ancient channel that received their drift and drainage: this channel discharged its waters from west to north for at least 12 miles of its course”—(Ann. Rept., 1875, p. 36.)

“These men know that the leads are not exhausted . . . that a channel in the older Tertiary drift crosses the richest portion of the gold-field, and at a depth of 330 feet has not been bottomed—that that channel must

in ancient times have received the local drainage, and that the discovered leads were in all probability tributary to it. Knowing all this, they hesitate to face ordinary mining difficulties that are of common occurrence in other parts of the world.”*

In a word, the alluvial miners found that the deepest portions of the leads were not necessarily the richest; that the channels appeared less definite as they reached deeper ground; that the gold contents ceased to be payable—so far as the miner of that time was concerned—after the channels had been followed downstream for certain distances. They knew from geographical principles that the buried channels of Forbes and Parkes must have discharged into main watercourses in the same way, as their surface equivalents do to-day, and they conjured up to themselves visions of deep, broad channels, receiving the local underground drainage and carrying rich gold deposits, which, when found, would give employment to hundreds, or even thousands, of men.

Nevertheless, one will readily observe that there is nothing in the nature of the main watercourses of to-day [such as the Billabong or Lachlan] to justify any expectation of rich gold contents in the main underground watercourses. That they exist is a necessity from geographical principles; but that they contain rich gold deposits is another matter. The present main streams, indeed, contain no payable gold deposits to justify the belief that the main buried watercourses possess rich gold contents.

Now in such a case as this, namely, where the deep underground channels of the district have not been found, the only knowledge one has for one's guidance is that which is based on a knowledge of the surrounding country and the principles of stream action. The miner simply knows that there are deep leads; and that they possessed much richer gold contents than those portions of the present surface watercourses situated vertically above them. He knows, moreover, that these leads must drain into the former main watercourses of the district, and that such old watercourses do not lie immediately underneath the present main watercourses. The problem is: first, to locate the beds; and, after having succeeded in this difficult task, to locate the gold deposits which may exist therein.

Location of Main Underground Channels.

It will be well in attempting any discussion as to the probability of locating rich gold deposits in the continuations downstream of the deep leads, to briefly trace the history of the Lachlan and the Billabong Creeks during the formation of the black soil plains. In recent times these channels have undergone remarkable changes. A glance at the accompanying geological map is sufficient to show one that the present main channel of the Parkes district flows through a wide plain of alluvium of its own making. Past Tichborne its course is south, thence it turns sharply to the west and passes through the comparatively narrow gap formed by Miller's Hill on the south and the Tichborne Hills to the north; thence it advances west and pierces the Jemalong or Coragery Range by means of a narrow gap which has been partially filled with alluvium. The earlier Billabong had a course different to its present one, and it is almost certain that in the near past it joined the Lachlan near the Jemalong Gap. When the district subsided the low-lying country was gradually buried under alluvium and

* Warden Dalton, Ann. Rept. Dept. Mines N. S. Wales for 1877, p. 75.

the bases of certain gaps, which previously had existed above the river level, now, by this process of valley-filling, occupied lower positions than the main stream. Through these in turn the largest streams would pass, as along the lines of quickest descent, each being kept, however, at about a uniform level. Thus the Lachlan at various times has occupied the Marsden, Jemalong, Gunning, and Goobang Gaps indifferently, and the Billabong or Goobang Creek has also joined the main stream now by way of one gap, and now by way of another, sometimes indeed joining it before reaching the notched range of quartzite lying from 12 to 15 miles west of Forbes and Parkes.

In the neighbourhood of Parkes and Tichborne the alluvium is several miles wide. The hills extending from Parkes to Tichborne shut in the old channel on the west, while the long low flinty range about four miles distant to the east, formed a wall to the Billabong Vall-y on that side. It is true that this eastern wall is breached by several alluviated gaps, any one of which, upon casual inspection, appears competent to have allowed the Billabong to escape in that direction in former times. The most important of these gaps is that now traversed by the Molong Road and the Upper Goobang Creek in its course to join the Billabong. The Goobang, however can be seen pouring over a rocky ledge where it has cut through the overlying alluvium, so it is evident that the old Billabong Creek could not have passed out that way to the east, because the alluvium exceeds 100 feet in depth to the immediate west. Similarly, it is doubtful whether any of the more northerly gaps in this belt (see map), and now alluviated, were low enough in recent times to allow of a passage first east and thence south for the Billabong to the Lachlan. On the other hand, the present valley of the Billabong, with its broad black-soil floor, is of just such dimensions as would suggest its formation by an important stream like that of the Billabong. One may then rest fairly well assured that the old Billabong Creek flowed south beneath the broad belt of alluvium as shown on the map, thence turning at right angles and flowing west past Tichborne but at some distance to the south of its present position. At Parkes it is almost certain that its old course was some distance to the east as also south of its present position at Tichborne. This may be proved in two ways. In the first place the Billabong Creek has been drawn over to the rocky walls of the valley between Parkes and Tichborne during the burial of the country under alluvium, whereas at the period that it was excavating a channel in the rock floor of the old broad valley, it is almost certain that such new channel would not be developed against the gently-sloping wall of the valley. In the second place the arrangement of the known channels of its tributaries, such as the Great Northern, the Welcome, the Tichborne, and the McGuiggan Leads, show that the old underground watercourse must have lain farther to the east at Parkes and to the south near Tichborne.

Less is known concerning the course of the old Lachlan River. It is certain that in earlier times it must have flowed farther to the south, because during the alluviation of its broad valley it has been crowded northwards to the low rocky wall on which stands the township of Forbes.

An interesting fact may be noted in connection with these old deep-buried watercourses. The deepest portion worked along the South Lead was that almost immediately underneath the present Lachlan River. This was not deeper than 225 feet, whereas Mr. C. S. Wilkinson* mentions the existence of a deep lead from 300 to 400 feet deep at a spot about a mile north-west

* Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 163.

from the town of Forbes. It is described as of Older Pliocene age, and as passing about half a mile west of the town. Mr. Warden Dalton evidently refers to this lead* when he mentions the occurrence of "a channel in the older tertiary drift" which crossed the richest portion of the gold-field, and had not been bottomed at a depth of 330 feet, and a channel which "must in ancient times have received the local drainage." Although the old shaft on this lead has now fallen into disrepair, I am informed by Mr. Hasemer of Forbes, that this lead is generally reported to be 500 feet deep. A shaft appears to have been sunk on a mass of coarse drift, capping a hill lying about $1\frac{1}{2}$ miles to the north-west of Forbes. At a depth exceeding 100 feet the "high bar" was met with; a drive was put in thence towards the centre of the channel and a monkey shaft about 200 feet sunk, which also bottomed on the high bar lower down. Other monkey shafts were put down until a hard cement was broken through at a depth of about 500 feet, when a great rush of water occurred, forcing the miners out of the workings. This was either in 1861 or 1862.

Although the brace of the shaft lies about 150 feet above the present river level, it will be seen that the bottom of the gutter just described lies at a much lower level than the deepest point yet proved along the South Lead. The physiographic evidence, however, does not go to show that this buried watercourse received the drainage of the leads at an earlier date, but rather that it was an independent tributary to the Lachlan at a time when the latter stream flowed farther to the south and occupied a position many hundreds of feet vertically below that which it occupies to-day. Anyone who considers that the deeply-buried watercourse just described is the buried Lachlan River must account for the excessively narrow channel which the river must have occupied while such a magnificent valley existed to the immediate south through which it might naturally be expected to flow. The peculiar course the Lachlan would have had to follow so as to enable it to get into such a narrow defile so far to the north would also be difficult to explain.

(2.) *Probability of payable gold being found in the main buried channels.*—Several points need consideration in this connection. Firstly, there are the relative steepnesses of slope which exist among the channel bases; and, secondly, there are the relative sizes of the auriferous area and the catchment area of the main stream traversing the former to be considered. It will be advisable to consider these, and to apply the results obtained to the case of the Forbes Parkes District.

(a) *Slope of channel base.*—Gold may be easily carried down for long distances on a steep channel base, whereas on a negligible slope the gold contents lie practically inert. We may now apply this test to the gutters of the deep leads of the district.

Forbes.—The gutter of the South Lead is steep, and falls about 200 feet in a run of about 2 miles. Rich gold deposits occurred along the gutter until the lead passed vertically beneath the present Lachlan. Large boulders were plentiful in the channel. It is certain that the old buried channel of the Lachlan, into which the South and Caledonian Leads empty farther down-stream, did not possess the same decided fall. Probably they did not possess grades steeper than from 300 to 400 feet in a traverse of from 30 to 50 miles.

* Ann. Rept. Dept. Mines N. S. Wales for 1877, p. 75.

Parkes.—The Welcome, M'Guiggan, and Great Northern Leads certainly commence with steep leads, but at short distances beyond their disappearance under the alluvium they lose their distinctive channels. For example, the Bushman, or Great Northern, spreads out into sandy patches at the point where it passes vertically beneath the Billabong Creek. At this point the gold values have also appreciably depreciated; and from an examination of the official records, the idea is gained that the channel base has grown too broad and sandy to follow, even at this short distance from the feeding reefs in the Parkes township itself, and that the gold values have become decidedly poorer. A similar state of affairs was revealed by mining operations along the Welcome, M'Guiggan's, and London Leads. In addition to this, from the principles of geography, one knows that in a district such as that of Forbes and Parkes, the old buried channel base of the Billabong Creek was less steeply inclined than those of its feeders. If it depended, therefore, for its gold contents upon the enrichments obtained from its tributaries, such as those here enumerated, one would not expect to find payable deposits along its base.

It appears strange, however, that such well-defined channels as those of the tributary leads we have just mentioned should pass into the flat sandy bottoms mentioned in the official records at such short distances from their sources, and were the skill of the Parkes and Forbes miners not so well known, one would think that here a false bottom had been mistaken for the bedrock.

(b) Relative sizes of the catchment area of a stream and the area of a gold belt drained either by a tributary of the same stream or by the stream itself.

This is a most important point for consideration, since it does not necessarily follow that the bed of a stream must contain payable gold simply because the stream itself traverses a belt of auriferous country. For, suppose a case, where an auriferous area is drained by small tributary streams which flow into a large watercourse, the drainage area of which is large as compared with the auriferous area traversed. We may assume, also, that the tributary streams just mentioned all contain payable alluvial gold, especially along their upper and steeper portions, but that along their more sluggish portions near the points of their intake by the main stream, they are scarcely payable, owing to the lesser concentration of the gold contents at such points, the lack of concentration being due, we will suppose, to the breadth and flatness of the channel bases. All other things being equal, the main channel, however, which drains an area very large as compared with that of the auriferous belt, has both a correspondingly large channel and mass of channel drift in which to distribute an equal amount of gold as that which occurs in the smaller channels. Under these circumstances one may expect to find gold deposits behind rock bars and at certain points opposite to, although slightly down-stream, of cutting curves, but the volume of the water of this main stream in flood-time will carry the fine gold down-stream for many miles and distribute it sparingly amongst its masses of drift. In a case such as this a payable deposit of gold may be found at an incredible distance down-stream, because the stream has transporting power sufficient to carry the gold down until a peculiarly favourable lodgment is found. On the other hand, since the amount of gold available for the whole stream is only that brought down by the tributaries, which themselves in turn are almost unpayable as they join the main stream, then in such a case the main channel may be classed as unpayable since the cost of the search for such isolated patches is altogether too great. An instance of such action is mentioned by Mr. J. E. Carne,

Assistant Government Geologist, for the Upper Hunter River at Denman. Here prospectors found gold in the bed of the river and immediately proceeded to prospect the rocks in the vicinity, although it was evident to the geologist that the nearest belt of auriferous country lay many miles upstream. In this case the Hunter floods had been so strong that alluvial gold had been carried for many miles down-stream and deposited at a spot specially well protected from stream influence. Nevertheless, the Hunter itself for many miles above this point contained no payable deposits of alluvial gold.

If the auriferous area, however, which is traversed by a large portion of the catchment area belonging to the main stream, and if at the same time the gold contents be exceedingly rich, then large payable deposits of alluvial gold may be expected to occur for miles down-stream. An example of this appears to occur along the Macquarie River channel and banks below the point of intake of the Turon River. In this case the country all around Hill End, Sofala, and Wattle Flat has shed great quantities of gold into the Turon (a powerful tributary of the Macquarie), which in turn has carried a large percentage of the same into the main stream, along which for many miles towards Wellington rich gold deposits have been deposited.

In this connection it will be advisable now to ascertain, if possible, the geographical and other relations existing formerly at Forbes and Parkes. In these localities the auriferous areas are confined to a narrow strip arranged along a north and south line. At Forbes the gold belt is very narrow, but doubtless it extends a little farther to the east underneath the alluvium. At Parkes the belt is somewhat wider, but an examination of the district shows that its eastern extension underneath the alluvium is very limited in extent. Furthermore, the bulk of the Billabong catchment area is away from the auriferous area. Not only is this so, but the ancient course of this stream was also practically east of the gold belt—that is, the Billabong itself traversed a small portion only of the gold belt, but relied, in the main, for its gold contents upon the material brought down by its tributaries. Similar reasoning may be extended to the case of the Lachlan River and its northerly tributary under the alluvium near Forbes, into which the King, Queen, Bald Hill, and other leads emptied.

At Parkes, again, the small buried watercourses known as the Welcome, the M'Guiggan, and the Great Northern ceased to be payable (under conditions existing at the time) before they even effected junctions with the Billabong. Nevertheless, only these small streams flowed over the rich gold belt. One would hardly expect the main channel of the district to be payable under such conditions; for in the first place it drains an area much larger than that of the Parkes gold belt, and for that reason alone its gold contents must be more scattered than are those of the streams confined to the belt; in the second place, the very tributaries upon which it depends, in the main, for its gold supply are not payable, apparently, as they leave the gold belt; and in the third place, the main channel evidently possessed a broad, shallow valley, and this would imply lack of concentration of the gold along its base. One would thus expect to find along such main buried channels:

- (1) A preponderance of unpayable drift.
- (2) Isolated patches of payable gold just below the points of intake of such tributaries as the Bushman, the Welcome, and the M'Guiggan South.

Similarly, the old main channel into which the Caledonian and South Leads of Forbes discharged may be expected to possess several pockets of payable gold in sheltered spots just below the points of intake of the tributaries.

The following notes may be found of use in the event of any future prospecting campaigns :—

(1.) *Forbes*.—(a) The flat immediately east of the Lachlan line of lode may contain a payable lead; a row of bores across the flat, and lying some little distance to the east, should reveal the presence of such, if existent. Thompson's Lead has not proved the lead far enough to the north, and the Bald Hill Lead is far to the north of the lowest portion worked of the Thompson's Lead.

(b) The Britannia Lode disappears to the south under the alluvium. Although the outcrop has disappeared, nevertheless the lode doubtless persists under the surface in this direction. It is well known that certain leads have been enriched by the gold shed from this auriferous line, and it is probable that other leads have been enriched to the south.

Again, it is evident that the South Lead must have received enrichments from the Britannia, and as this line was not buried during the formation of the South Lead, it is highly probable that rich deposits have been deposited from that source on the "rim rock" or the channel sides of the South Lead.

(c) The Lachlan River, now buried, may contain a rich deposit just below its point of intake of the South Lead. This, however, could only be expected if the old Lachlan River flowed much to the south of its present position.

(2.) *Parkes*.—In this district attention should be directed to following the tributary leads down-stream rather than to a search for the old main channel. If the tributary leads are found to become unpayable, we can hardly expect good returns from the main channel when the latter depends upon these tributaries for its gold contents. A simple comparison with the present condition of things there will help us to understand this point. The shallow leads of Parkes paid very well until they left the gold belt and entered the alluvial plain. There the gutters became too flat, the channels too unstable, and the drift too fine and too great in quantity to allow of profitable mining along those channels. Furthermore, the main present Billabong channel appears to have no payable gold deposits along it. Of course, this analogy must not be strained so far as to say that because the present shallow leads paid while traversing the gold belt, and that both they, as well as the present Billabong channel, contain no payable deposits while crossing the alluvium, therefore the old buried Billabong channel will contain no payable gold. Nevertheless, the analogy may safely be carried this far, namely, that there is much less chance of finding payable gold in the old main buried channel than in its buried tributaries, such as the M'Guiggan and the Bushman. Therefore, if these tributaries become unpayable when followed down-stream, we may rest assured that unless some unexpected lode has been crossed by the main stream, then it is idle to expect payable gold to occur therein.

When one looks to leads in other districts, one sees that this is so. Theoretically also, it must be so from mechanical considerations. Thus the Eucumbene River at Kiandra was payable as it traversed the narrow gold belt, but it became unremunerative immediately below that belt. Had the Eucumbene here possessed a large catchment area as compared with that of

the gold belt at Kiandra, it is doubtful whether even at this spot it would have contained payable alluvial deposits. The case of the Hunter, cited above, is another instance. The Shotover, in New Zealand, at first sight appears to be a remarkable exception to this rule. In this case, however, the stream traverses an auriferous belt of enormous area. The Macquarie River, below the point of intake of the Turon, is also another example of a main stream enriched by a powerful tributary, which has carried great quantities of gold into it.

(3.) This chapter on the leads may perhaps be fittingly closed with a page or two descriptive of the methods formerly adopted in taking up the ground, and of those adopted in the working of the same.

According to Mr. Richard James Barton, of Forbes, the Gold Commissioners allowed only 10 feet per man along the width of the South Lead. At a later period, areas 40 feet square were allowed to each party of four. It will be seen at once how such a system practically prohibited the expenditure of much capital in working the claims. The ground was wet, yet each small party, in ways best known to itself, had to contend with heavy water, with swelling bottom, and with running ground. Each party worked with frantic haste, so as not to be left to contend singly with the water. One serious difficulty arose in the process of sinking through the coarse drifts, which averaged from 15 to 20 feet in thickness, and which occurred generally at a depth of about 40 feet from the present surface. These were saturated with water, and the greatest difficulty was experienced in sinking through them to the underlying impervious clays. If the alluvial miner could sink and secure his shaft through these unstable structures and regulate it so as to prevent the water from seeping down it to the workings below, he could work the gutter in comparative dryness and comfort. After repeated failures, recourse was had finally to a method of sinking through the watery drift with watertight boxes shod with iron. These were then anchored firmly into the impervious clays beneath, and the space between the box and the drift puddled so as to be watertight. Sometimes "box-in-box" structures were employed in sinking through the drift, and the services of professional divers were also sought in this connection.

With the progress of time attempts were made to help the alluvial miner in various ways, notably by granting larger claims. One of the later systems of leasing the ground may be here briefly described. Alluvial ground was leased either in block or in frontage claims. If the ground was less than 100 feet deep it was leased in block claims, while under the frontage system each party was allowed a frontage of a certain length and width along the gutter when the deepest point of such gutter lay 100 feet below the surface. Inasmuch as the course of the lead could only be known approximately at points either immediately below or above any point at which it had been located definitely by the prospectors, the direction in which the lead would run was assumed, and frontage lines along that line were designed. As the gutter was proved by the prospectors so this frontage line was swung sideways and the side claims were adjusted at the same time. The only condition for holding claims by this arrangement prior to pegging out was by employing someone to watch or "shepherd" the claim for two hours a day.

220 feet square was a common size for a block claim.

Naturally, such a system as that of the frontage had its own particular disadvantages and was productive of much dishonesty. The following graphic account of the deplorable results which accrued from the employment of such a system is taken from Mr. Warden Dalton's report in "Mines and Mineral Statistics" (1875, p. 31).

"As these leads became gradually developed and were traced to the margin of the creek (Billabong Ck.—E.C.A.) . . . it was clear that the present channel of drainage had been formed subsequently to the denudation of the hills . . . , and that the bed of an older stream must lie farther to the southward and be covered by the alluvial deposits that stretch towards the Lachlan River, . . . adventurous prospecting parties crossed the stream, and extended their operations to within a few miles of Forbes; they were followed by hundreds of shepherds who occupied long lines of imaginary leads in anticipation of the red flag. Land speculators also followed like sharks in their wake, and suddenly discovered that a waterless country that had been permitted to lie unoccupied by permanent settlers up to the present time was the only place where they could select homesteads. . . .

"As the prospectors proceeded they discovered . . . that long ridges lay concealed beneath a level surface. . . . Every new ridge created a demand for a new line. The swinging of base lines was incessant, and no little confusion and litigation was the result. In fact, the operations of the miners on these wide levels appeared more like the evolutions of an army in the field than anything else—marking claims had resolved into a game of chess."

Gold Yields of Leads from Forbes and Parkes.

Forbes, 1862-1864.—Between these dates the famous South and Caledonian Leads, with their tributaries, yielded over 300,000 oz. of gold.

Parkes.—Between 1871 and the close of 1873 the Parkes leads (No Mistake, Great Northern, and Welcome Groups) yielded about 50,000 oz. gold.

From March, 1874, until the close of 1879, the Parkes leads (London, Tichborne, Wapping Butcher, and McGuiggan Groups) produced about 156,000 oz. gold.

B. Quartz veins associated with intrusive anesites.

These include the Britannia, the Lachlan, the Nil Desperandum, the North Lachlan, the Federal, the Nibblers, the Koh-i-noor (?), the Buchanan, the Phoenix, the Bonnie Dundee, the Bushman, the Pioneer, and the Dayspring veins. A number of minor veins are to be included also in this list, such as those which were found within the township of Forbes itself, and those which occur along the line from Miller's Hill (Tom's Knoll), at Tichborne, to the Dayspring Mine, lying about 2 miles north of Parkes. A glance at the map reveals the fact that all the auriferous deposits just enumerated occur either in or alongside of a long north and south line of compact augite andesites, the strikes of the igneous and associated sedimentary rocks being practically coincident. At times the veins either follow the junction of the andesites with the sediments, or they cut across the line of strike of the igneous rocks. These in the former class are the longer veins. Of these, the Lachlan and Buchanan Lines are good examples, while the Bushman and Phoenix Lines are typical members of the cross veins. Although these veins appear to be so intimately related to the associated andesites, nevertheless the latter themselves have been intensely altered in many places by the auriferous solutions. Thus clouding of feldspars, development of abundant pyrites, and more or less complete replacement of andesite by quartz and

ferruginous material, are common features over considerable distances alongside the fissures. These observations prove that the andesites themselves did not bring up the gold values, but that they either—

- (1) Fractured and so heated the country that waters were set in circulation which leached out gold from the crumpled Ordovician (?) sediments of the district and deposited them along lines of shrinkage developed in turn by the cooling of the andesites; or—
- (2) Cooled and contracted after intrusion of the pre-Silurian sediments and thus made way for the ascent of plutonic waters given off by the same underlying hot magma as that of which the andesites in turn have been but a secretion. These circulating waters may have obtained their gold contents either from the magma itself or by a leaching process from the associated rocks in their upward movement.

Another possible explanation for the quartz veins of this class is that they were derived in part from the underlying magma and in part also from the other rocks associated with the andesites.

In any case, here, as at all other places observed by the writer in New South Wales, gold deposits have arisen as direct introductions by circulating waters (or water and gas) and not as segregations from the associated igneous masses during the cooling of the same. Gold has been reported as occurring in unaltered granite, rhyolite, and other igneous rocks in New South Wales, but in each case it may be seen to have been introduced by foreign water, which has either replaced the associated igneous rocks in part with its own dissolved material, thus giving rise to deposits such as mica, pyrites, calcite, quartz, and gold, or has deposited quartz and gold along thin joint faces of rocks in localities of heavy faulting. Timbirra and Grassy Gully are examples of the former action, while certain of the Yalwal gold occurrences are examples of both classes of action.

In each case, also, the solutions from which the gold has been precipitated cannot be shown to have possessed any direct connection with the associated igneous rocks.

The cross veins, it has been mentioned, lie almost at right angles to the general line of strike of the andesites, and they appear to be depositions along cross-cracks due to the cooling and the consequent shrinkage of the intrusive masses. As the mining workings were inaccessible during the time of the geological survey of the field, the relations of the strike and cross veins are not known, neither is it known whether any of the veins themselves have been intruded by dykes later than the general andesite mass. The Bushman Line would be a good locality to examine in this connection.*

Class of Veins.—The veins, whether of the strike or of the cross variety, most frequently represent fillings of fissures; nevertheless, a considerable amount of replacement of the country has taken place alongside of the original fissures. By this process of replacement large chambers, such as those described in the chapter on the Lachlan Lodes, were formed at the expense of the country rock. The Britannia Lode appears to contain large replacement bodies.

Ore Associates.—The minerals associated with the gold are quartz, iron, and arsenical pyrites, fahlore (Dayspring), and calcite, with small quantities, at times, of copper and galena. The quartz may be white, compact, opaque, transparent, or ferruginous. Again, it may be pyritic, cellular, and brecciated. The brecciated appearance is frequently due to the percolation of silica solutions along a set of tiny branching cracks, and to a gradual

* Since writing the above, Mr. J. Wann, Manager of the Bushman Mine, assures me that an andesite dyke has cut through the line of the Bushman Lode proper.

replacement of the walls of these cracks by the silica ; the cessation of activity in the replacing solutions during an early stage giving rise to the appearance of breccias.

The cavernous nature of the quartz of the veins is most frequently due to the leaching out of the pyritic contents of the quartz. Water level is found in the Forbes-Parkes district at depths varying from 75 to 150 feet from the surface, and above this level the quartz is frequently ferruginous and cavernous, while below that level the quartz contains an abundance of both iron and arsenical pyrites. In Boyle's Mine the arsenical pyrites occurs in large irregularly-shaped pieces, very fine in texture and very tough in character.

Ore Values.—Owing to inability to examine the underground workings of these mines, the writer, in attempting a satisfactory account of the genesis of the ore-bodies, has been compelled to rely upon the information derived from an examination of the surface geology, of the ore fragments raised, of the "mullock tips" at the various mines, and of the plans and official records of the mines.

One interesting fact may here be mentioned. In some of the "spoil heaps" from the Lachlan lodes, the writer has seen an abundance of carbonaceous or graphitic slates. The occurrence of this material in such abundance and in such connection suggests that it has had some influence on the precipitation of gold along this line of lode, since somewhat similar andesites, occurring in hard jasperoid strata in the neighbourhood, do not appear to contain payable gold lodes.

Several brief notes which were made on the lodes in the earlier days of the field may be here reproduced.

"During 1862, 1863, and 1864, the Billabong was celebrated for its quartz reefs. Nine of these were worked efficiently. Near the surface the produce was from 2 to 3 oz. of gold per ton of stone ; this gradually decreased until at the depth of 150 to 180 feet a change in the investing rock occurred ; below this the respective mines did not pay the expense of working, when the place was abandoned."*

"In 1862, as well as 1872, the Billabong Gold Field gave some considerable evidence of the existence of rich quartz reefs within its boundaries . . . but in each decade quartz workings were of short duration only.†

"Between the dates October, 1862, and December, 1867, the lodes of Parkes yielded 40,000 oz. of gold."‡

"Many of the reefs that have been tested contain a small quantity of free gold associated with arsenical pyrites and galena, the latter in small quantities. Near the surface these components are more or less decomposed, and the sulphurets are replaced by peroxide of iron, and when this decomposition has taken place, free gold may be more frequently observed. As the reefs descend decomposition ceases, and in some instances free gold disappears. The decomposition may be due to the percolation of rain-water from the surface, and may extend no deeper than it can penetrate. This may account in some degree for the fact that the reefs of this district have always proved to be most productive near the surface or in the immediate vicinity of an intrusive dyke between which and the originally softer rocks that form the walls of its fissure, water charged with carbonic acid, soda, chlorine, and other chemical agents may find its way to a great depth."§

* Warden Dalton, Ann. Rept. Dept. Mines N. S. Wales for 1877, p. 80.

† Margules, Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 89.

‡ Extract from Warden Sharpe's Report, (Prospecting Board, 87/15730).

§ Warden Dalton, Ann. Rept. Dept. Mines for N. S. Wales 1875, p. 39.

From these extracts it is evident that the earlier mining men ascertained the upper portions of the veins at Parkes and Forbes to be very profitable, but it is also evident that below a depth of 200 feet they considered them to be unprofitable. Later prospecting campaigns along these discarded lines of lodes, however, have shown the latter idea to be erroneous. One has only to mention the revival of mining operations along the Koh-i-noor, the Bushman, the Buchanan, the Bonnie Dundee, and the Dayspring Mines to show the fallacy of the idea that this is a "worked out" field.

It is difficult, in the present state of our knowledge, to account for the cause of the ore enrichments. Mr. H. Hooke, Government Mining Inspector, refers those of the Bushman Lode to the influence of "droppers," or subsidiary veins, and he states the occurrence of at least two shoots. Mr. J. E. Wann, a former manager of the Bushman Mine, says that the "shoot" of the Bushman was about 700 feet in length, near the surface, and that it had a pitch to the west, the values decreasing from several ounces to each ton of stone treated between the 300 and 400 feet levels to about $7\frac{1}{2}$ dwt. at a depth of 900 feet. Both the Birthday and Buchanan lines of lode are said to possess distinct shoots of ore having dips more or less vertical. The writer has not seen the vein below ground.

Only one belt of Andesite related to the Lodes.

An interesting point in connection with the veins under consideration is their apparent dependence upon one belt only of andesites. A glance at the map will show that Grenfell, Forbes, Parkes, Alectown, and Tomingley lie practically along the same line of strike. In the middle section of this stretch of country, 100 miles in length, the present survey has revealed the absolute association of the two, the andesites appearing to stand in some causal relation to the gold veins. The following quotation from a report of Mr. C. S. Wilkinson is instructive in this connection:—"With but few exceptions I have noticed that in all the gold-fields recently examined, hornblende granites and intrusive greenstone or diorite are the original source, whence the gold found in the alluvial deposits has been derived. At Grenfell this is very marked. There we have a very large mass of porphyry intruding upper Silurian schists. Quartz reefs, varying in thickness from that of a mere thread to over 10 feet, traverse the intrusive rock in a north-easterly direction, and in some instances pass into the adjoining schists; but though richly auriferous while on the former rocks, they cease to be so immediately on entering the schists."^{*}

The schists Mr. Wilkinson refers to here are possibly the equivalents of the schistose slates of the Forbes-Parkes gold belt.

Again, Mr. Danvers Power mentions the intimate association of the gold at Tomingley with compact andesites, the lustrous slates of the district being of Ordovician age.

Of all the andesite belts of Forbes and Parkes, however, the gold appears to be intimately associated with one only; for with the much larger masses east, west, and north of the one under consideration, no payable reefs appear to be associated. From what has been said, however, on a previous page, it is possible that the gold values are also due in part to the presence of graphitic or carbonaceous slates and schists.

C. Auriferous Quartz Bodies arranged along Zones of Crushing.

To the west of the long north-and-south line of intrusive andesites lie various zones of crushed material which are at once parallel to the andesite

^{*} Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 89.

line, to the general strike of the pre-Silurian sediments, and to the planes of cleavage in the latter. Within these zones the rocks have been altered in places to schists. The weaker rocks only, such as the shales, have been cleaved and crushed; the indurated claystones and the thicker of the cherty bands, on the other hand, have not been cleaved, but have been crumpled, the bedding planes being revealed in recent excavations.

The most distinctive line of such crushing is that along which the Magpie, the McGuiggan's, the Victoria, the London, the Newhaven, the Band of Hope, the Mount Morgan, and the Strickland (Parkes) lodes occur. The lodes just enumerated lie in a wide zone of alteration. All traces of bedding planes are practically obliterated except at spots where coarser sediments are associated with the more finely-textured ones, and a highly cleaved appearance characterises the rocks of the zone. A belt of contemporaneous andesitic lava flows accompanies the belt in part (see map), and these lavas possess a banded appearance in places, while they present a crushed appearance in others, as at the Mount Morgan and Strickland Mines. In this general zone of alteration are evidences of parallel lines of more intense crushing. The London Lode may be taken as the type. In this example the ore-body is arranged parallel to the strike of the associated sediments. It varies considerably in width, and it appears to consist of a series of large lenses of ore arranged along a line of crushing. The mining operations in the London Mine appear to have been confined to the winning of one of these lenses. The lens itself is not composed of solid quartz, but is built up by a whole series of small lenses similarly shaped and similarly arranged to the mass of the ore-body itself.

The small lenses which form the texture of the main one lie packed closely together with their vertical axes all parallel to each other. Their surfaces, moreover, curve harmoniously with the bent cleavage planes of the country. The cement of the quartz lenses is of crushed slate, and the gold values appear to occur rather in the cementing material than in the quartz. The accompanying text figure explains the method of occurrence.

From these observations it is evident that the veins of this type were formed at considerable depths below the earth's surface, and that they were formed during the movement which so powerfully affected the country. As the rocks underwent gradual strain and change, solutions containing silica and gold appear to have gradually replaced the country. The peculiar lenticular appearance of the quartz masses and their surfaces, which curve sympathetically with those of the country, may be simply explained. For in a region

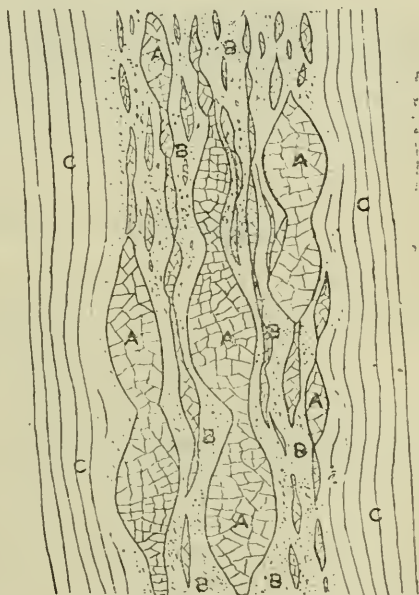


FIG. 5.—Sketch section of London ore body near southern end of open cut.

- A—Quartz lenses.
- B—Crushed slate infilling with films of graphitic material. The cementing material is said to contain higher gold values than the quartz lenses.
- C—Cleaved slate country.

where great pressures are present, it is evident that the heat of the wandering solutions may be considerably higher than that of boiling water under ordinary atmospheric pressure. Increase of pressure in such a solution also generally increases its solvent powers, while similarly decrease of pressure generally decreases its solvent powers. Thus under conditions of great pressure, the end of a crystal or granule of country will tend to be dissolved in a small degree by the wandering solutions, whereas upon the pressure being slightly relieved, as at the forward end of the crystal or granule, a portion of the material in solution will be redeposited. In this way a crystal may be continually dissolved and redeposited, and may even appear to grow at the head, while at the same time it is being continuously dissolved at the rear. An analogy may be found in the action of water on masses of sand in a stream-bed. Thus a stream may cut into a mass of sand at its upper end and deposit it in part on the nose, or point of least pressure. In this way a cigar-shaped forward end may often be seen on a sand mass, the nose so formed travelling down-stream. Without straining the analogy too far, one can see how a lenticular mass of impure quartz may thus be formed from a nucleus of slate or similar rock. The end result is seen as a mass of quartz lenses cemented by crushed slate.

It may be interesting at this stage to discuss the relationship, if any, existing between the veins associated with the andesitic intrusions and those associated with the shear planes or zones of strain. Upon examination each appears to have a fairly deeply-seated origin; each group is apparently absent from the neighbouring Silurian sediments, and each appears to be related to the strong earth movements which folded and cleaved the associated sediments. It is probable that the strong earth movements just mentioned gave rise to strong shearing and faulting action, with the production of quartz reefs, and that, at a slightly later date, the andesites ascended along one such long line of weakness. These in turn became consolidated, and after a brief interval of time heated waters rose alongside these igneous masses, and formed the well-known lodes of the field.

DESCRIPTIONS OF MINING WORKINGS.

A.—THE LEADS.

(a.) Forbes.

i. *The South Lead Group (South Lead, North Lead, Madman's, Grassall's and Britannia Leads.)*

The South Lead, with its continuation the North Lead, was not only the first, but also one of the most famous deep leads known in the history of gold-mining in New South Wales. During the period embracing the years 1862, 1863, and 1864 both it and the associated deep leads were energetically worked. The claims were so small (40 feet square) as to prevent the erection of machinery competent to cope with the water, the running ground, and the swelling bottoms encountered. In such dangerous grounds miners were dependent in great measure upon the proximity of other working claims to keep the water down. Having also before them the prospect of winning very rich dirt from the centre of the gutter, they would not waste time in dangerous ground which yielded only from half-an-ounce to an ounce per ton of dirt. "Strenuous efforts were made by each party to get their share

of the gutter worked out before that of the adjoining shareholders, fearing that if these men worked out and abandoned the lead before they had secured the best of their wash-stuff, they would lose it; as they knew that single-handed they could not cope with the water and other obstacles that were known to overlay the auriferous drift."* In 1877† it was supposed that the sides of the gutter had not been worked, and a proposal was made by Mr. Phillip Davies to work it with the aid of powerful pumping machinery. Mr. Davies pointed out the disabilities under which the original prospectors of the South Lead had striven, and how that the very remunerative ground only had been worked. It was certainly known that at depths increasing progressively from 110 to 150 feet, eighty-two consecutive claims had struck payable gold; it was known, moreover, that a large gold reef, called the Britannia, had enriched it along its lower course.

In the early days the miner was accustomed to sink a shaft into the alluvium. At a varying depth below this an old river drift containing much water was encountered, while below this drift a thick layer of impervious clay was found to exist. Much difficulty was experienced in carrying the shafts dry through the drift into the underlying clay. They were usually carried down through the drift in the form of boxes, either with or without the aid of divers; the spaces between the boxes and the walls being tightly packed, and the box then securely anchored into the dry underlying clay band. A dry shaft was thus secured.

About the year 1876 attention was directed to the advisability of re-working these old alluvial gutters, and in 1877 Mr. Phillip Davies estimated the cost of winning the wash-dirt as not exceeding 10s. per load.

As a result of these representations the South Lead Gold-mining Co., Ltd., was formed for the purpose of working 50 acres of old and abandoned ground at the lower end of the South Lead, on the Lachlan River, at Forbes. Control of more than half-a-mile along the gutter of the "lead" was secured, and the management was entrusted to Mr. Davies. The old shaft was repaired and enlarged, a water lodgment constructed, and the shaft was sunk 30 feet deeper. A large chamber was opened out; 300 feet of lower main levels were driven, and 1,500 feet of drives in wash-dirt were completed. From these drives 900 tons of wash-dirt were won, which yielded 204 ozs. of gold.

The mine was fitted up with two steam-engines, each of 18 horse-power, and with two Cornish boilers. A puddling engine was employed to drive two cast-iron puddling machines, elevated 24 feet from the surface, besides working a surface pump to supply the sluice.

This mine made water at the rate of 50 gallons a minute. The wear and tear on the winding-engine ropes was found too great, and when, at the close of 1879, the South Lead Company's mine was swamped out, there were added to the plant a 16-inch cylinder pumping-engine and a boiler 22 feet long, as well as a set of cast-iron pumps of 8 inches diameter. The water was raised from a depth of 247 feet.

The company extended their underground workings—chiefly north and west—by means of underlevels, and by such methods the South Lead gutter was ascertained to exceed 350 feet in width, forming a well-defined bed of auriferous wash-dirt averaging 2 feet 6 inches in thickness, and varying from 3 to 10 dwt. a load.

* Warden Dalton, Ann. Rept. Dept. Mines N. S. Wales for 1877, p. 75.

† *Op. cit.*, 1877, p. 82, 87.

During the year 1880 it was seen that to work this extensive lead successfully it would be necessary to thoroughly drain it. A scheme was therefore devised to raise an additional £20,000 capital, so as to sink a new shaft and attach thereto another large pumping plant. No money being forthcoming, however, mining operations were abandoned.

In December, 1881, the mine had been idle for twelve months, and although shareholders urged the need of prospecting for side-leads, the machinery was allowed to fall into disrepair.

In spite of this failure to work the South Lead at a profit, another determined effort was made to exploit it during the year 1886. Three companies took up claims, namely, the Nil Desperandum Gold-mining Company, the Crinoline, and the Forbes Alluvial Gold-mining Company.

The following description of the efforts made by these companies to win the gold of the South Lead has been copied from the official records :—

“The Nil Desperandum Gold-mining Company holds three leases of 25 acres each in area, and embracing each side of the river. The main shaft is 215 feet deep to the wash-dirt, and a further depth of 20 feet to the bottom. The main drive is 284 feet long, west of the shaft, with a cross-drive 50 feet from the shaft, bearing north 78 feet; east drive 120 feet from shaft, driven 90 feet; north drive 150 feet from shaft. At this point two cross-drives were opened out east and west—the east drive 96 feet, the west drive 82 feet. These last drives are on payable gold. For 140 feet of their length the wash-dirt is from two to three feet in thickness, and averaged 6 dwt. to the load for about 120 loads.

“The machinery employed on this mine consists of a 20-horse power horizontal steam-engine, for winding and puddling; also two Tangye pumps; 28 men are employed on the mine at present, in three shifts of eight hours each shift.

“Coming north, on the same lead, is the mine known as the Crinoline Gold-mining Company. This company holds two extended claims. Their main shaft is sunk 160 feet to wash-dirt, through 35 feet of sand drift. For getting through the drift, 40 feet of watertight boxes of sawn timber were used at a heavy cost.

“The third claim at work on the South Lead is that called The Forbes Alluvial Gold-mining Company. The area is 25 acres. The main shaft is sunk 30 feet to sand drift, 35 feet through that, and then 12 feet to bottom. In this mine also water tight boxes had to be used, the men working in a diving-dress. The machinery to be used in this mine is one 16-horse power portable engine, one Tangye pump, puddling machines, and winding gear. To get through the drift the boxes used are single, and all the sand drift had to be raised by divers, using the proper dress for the purpose. The drift to be gone through was 45 feet in thickness.”*

All of these mines were taken up over old and abandoned ground. The Crinoline appears to have been the only one which obtained good returns.

In 1889 the Forbes Alluvial Company found several tributary leads, all of which, however, were too wet for this company to work. In the same year the Crinoline and the Try Again (old Nil Desperandum) had been idle for a considerable time.

In 1891, Lewis and party prospected the South Lead and found payable wash-dirt.

* Ann. Rep. Dept. Mines N. S. Wales for 1896, p. 62.

In 1893, again, Chester, Sully and party received aid from the Prospecting Vote to sink a shaft on the South Lead. They bottomed at 215 feet on wash which yielded half-an-ounce to the load.

Thence to the present time the South Lead appears to have been almost completely neglected. In 1896 Sinclair's Reef was found, and attention appears to have been directed from alluvial mining to reefing operations.

The influence of the Britannia Lode on the gold contents of the South Lead must not be overlooked. This has already been discussed in the general Chapter on the Leads.

A brief mention of the three leads ascertained to be dependent for their gold contents on the Britannia Lode may here be made. Others also may hereafter be found further to the South. The three known are Madman's, Grassatt's and the Britannia. They are short but rich tributaries of the South Lead, and they enter it from the right bank. In prospecting their gutters it was found that they headed in the Britannia Lode which is situated about half-a-mile south of the Forbes post-office. The main South Lead was very rich just below the points of intake of these tributaries.

Both the Madman and the Grassatt Leads appear to have been worked out but the Britannia has only been worked at its lower end, its connection with the Britannia lode not having been definitely proved. In the writer's opinion the upstream course of the lead will be found to be considerably further to the south than has been hitherto imagined. The reason assigned for not tracing the lead upstream is that the thickness of drift is too great as compared with that of the underlying clays. The clays being relatively thin the thick mass of overlying drift cannot be supported during mining operations.

ii. The Caledonian Group (Mathieson, Union, Victoria and Caledonian Leads).

Very little exact information exists concerning these leads.

The famous South Lead was found in 1861, and in the beginning of 1862 the Victoria was discovered. A couple of years later the head of the Union was located under Mr. J. Barton's house near the Forbes railway station. The discovery of the Caledonian followed shortly after that of the Union, and a little later again the King and Queen Leads were found to the north of the Doroobalgie railway-station. Prior to 1870 both the Thompson and Mathieson's Leads were worked, the former being the earlier discovery of the two. The Bald Hill Lead was not found until some time later (1874?) The date of the discovery of the Rise and Shine Lead is unknown.

Mathieson Lead.—Both the Mathieson and Thompson Leads head in small bosses of andesite which form the crest of the hill at the railway trucking yards at Forbes. Mathieson's Lead is shallow and of short length. It is tributary to the Caledonian Lead which picks up the Victoria at a point still lower down. Very little is known of the early working of the Mathieson beyond the fact that it was rich; that it possessed a rough and steep gutter, and that it is now practically worked out. A large nugget (8 lb.) was found here about the close of the year 1870 by the late Mr. R. Barton.

The Union Lead.—Very little is known of the early history of this lead. Along with some other gutters of Forbes, its richer portions were worked hurriedly before the close of 1864. In 1875, a party of eight found very good "surfacing" at the Union. In 1890, Lynch and party were working this lead. The depth of the gutter worked by them was about 80 feet.

The Victoria.—In the early days, magnificent gold values were obtained from this buried watercourse. The lead headed in the township of Forbes near Tattersall's Hotel, but a short distance downstream, the ground became deep. The early records of the working of this lead—as also those of the South and Caledonian Leads—are to be found in the reports of the Gold Commissioners, in the pages of the *Sydney Morning Herald* and of the *Forbes Times*. The history of the pioneer attempts is very similar to that of the South Lead. On the accompanying map, the Victoria is shown as tributary to the Caledonian Lead. Below the point of junction, the channel of the Caledonian was well defined, but the gold values appear to have been poor.

In 1877, a party of six took up an extended claim on the Victoria. This was one of several attempts about this time to work the deep wet leads of Forbes, after they had lain idle for about fifteen years. Like the others, this attempt was unsuccessful. The bottom box, sunk through the drift, bulged, and allowed a passage for the heavy water. Such mishaps were common when the bottom box had not been sunk sufficiently deep into the clay before "puddling back" was commenced. The Department of Mines loaned the party a diving-dress, but while operating with it, a flood came and washed the shaft timbers away. Work was then abandoned in 1879. This incident in the history of deep-lead mining at Forbes is mentioned to show the difficulties attendant on working the leads of this locality.

In 1889, the Phoenix Gold-mining Company worked the Victoria. Heavy water was encountered, but 200 oz. of gold was recovered. A quartz vein containing coarse gold was also struck in the bottom of the gutter.

The Caledonian.—This lead heads near the railway line and picks up the Victoria near the Rifle Butts. Below the Parkes Road, the ground is deep. From the head of the lead to its junction with the Victoria the ground was rich, but it is said to be practically worked out at present. Below the point of intake of its rich tributary, the Victoria, a definite channel was found, which however contained but very little payable gold.

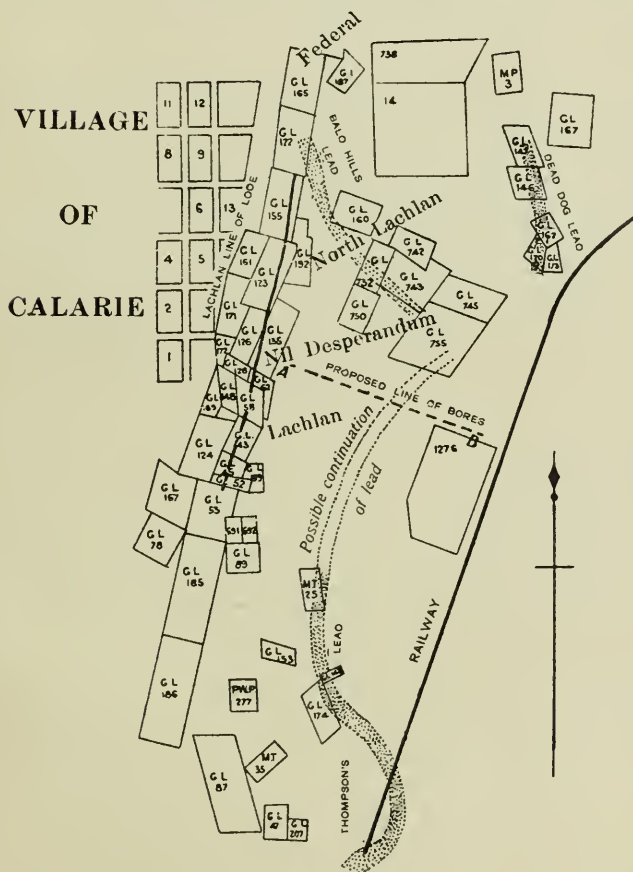
iii. *The Bald Hill Lead.*

This lead appears to have derived its gold contents from the northern continuation of the lode known as the Lachlan; indeed, it is reported that the North Lachlan Lode itself was discovered by the process of tracing the Bald Hill Lead upstream. The lead was discovered about the year 1874; the gutter worked was 180 feet below the surface. During this first attempt it was worked without profit, and abandoned temporarily in 1875. In August, 1876, Mathieson and party took up portion of it as an extended claim. The sinking at first was through clay, then at a depth through masses of large boulders, the boulders being derived from the associated hills. The wash consisted of a decomposed breccia, clay and quartz gravel, while immediately over the wash came boulders of quartz and igneous rocks. The bottom was soft and swelling, and was composed of slate and allied rocks. The western bank of the channel was well-defined, but the eastern one had not been found in 1876—the wash exposed during that year being 30 inches in thickness and from 15 to 50 feet in width.

The first claims made about 1,800 gallons of water in 24 hours. The general return from the lead was from 5 to 12 dwt. per load. "The first occupants possessed neither whims nor adequate machinery for working deep

*Showing the relative positions of the LACHLAN LODGE and the
THOMPSON and BALD HILLS LEADS,
CALARIE, near FORBES.*

Scale 0 20 40 Chains



and wet ground, and the water was constantly ruining their shafts and drives. . . . This party have already raised and washed 100 loads; the result was 70 ounces. The value of the gold is £3 10s. 6d. per ounce." *

In 1879, a new shaft was put down on this lead, and the bottom of the gutter was reached at a depth of 200 feet from the surface. The shaft was slabbed and centred, with a well-hole 9 feet deep, because of the heavy water encountered. A drive was put in 120 feet south and 250 feet north. The width of the face exposed thus was about 60 feet, and the wash-dirt was from 18 inches to 2 feet thick; 700 loads of wash-dirt were puddled for a yield of 291 oz. of gold.

During 1883, more determined efforts were made to test this lead. Two leases were taken up by the British Standard Company. The shafts put down (several in number), bottomed at 180 feet; the wash exposed was 100 feet wide and from 2 to 3 feet in thickness, and it yielded from 10 to 15 dwt. per load. In all, 844 oz. of gold were obtained by the company for the year.

This success induced many parties to prospect the ground both north and south of the company's leases. Among these, Murphy and party had a trial washing of 8 loads, which yielded 5 oz. 12 dwt. of gold.

Upon the whole, however, this trial by the various parties of the Bald Hill Lead was not successful, and the claims were abandoned.

In 1884, another party worked the British Standard ground afresh. Their shaft was 190 feet deep, and the drives totalled 800 or 900 feet in length. The depth of the wash was 2 feet, and its width from 70 to 80 feet, of which 50 feet carried gold. During this year the company paid working expenses; 25 men were employed, and £1,000 worth of machinery was purchased.

Keeley and party about the same time carried out from 400 to 500 feet of driving on the lead east of the British Standard claim.

In 1885 the British Standard Company was wound up.

During the same year the late Mr. C. S. Wilkinson made the following report upon this lead.† "The Bald Hill Lead near Forbes trends in a southeasterly direction between hills of Silurian (sediments) with diorite. The sinking is from 186 feet to 240 feet deep, and the channel varies in width from 30 feet to 200 feet, the wash-dirt, which is said to yield from 3 dwt. to 4 oz. of gold per load, being 2 to 3 feet thick. The sinking is nearly dry, and not much water makes at the bottom. Some of the gold obtained is so extremely fine that it has been called "flour" or "paint" gold. The wash consists of sub-angular drift of quartz, quartzite, and large round boulders of diorite.

In 1889 the Bald Hills Extended Gold mining Company worked during the whole of the year. An ordinary whim and a horse puddling machine were used only, and upwards of 2,000 loads of wash-dirt were put through for a yield of about 650 oz. gold. This company, later, erected a steam-winding plant, and sunk a main engine shaft to a depth of 180 feet.

During the year 1890 mining operations in the Forbes district were at a very low ebb. The Bald Hills Company carried out a great deal of prospecting, but failed to realise more than 137 oz. gold from 600 loads of dirt. The company ceased work; removed their machinery; and returned the auger-drill, which had been lent to them by the Department of Mines.

* Warden Dalton, Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 48.

† Ann. Rept. Dept. Mines N. S. Wales for 1885, p. 128.

Thompson's Lead.—This lead takes its origin in the patch of andesite near the trucking-yards at Forbes. At first the lead follows the railway line; then crosses it; then doubles back on itself across the railway again; thence it flows for a short distance towards the Lachlan Mine, but has not been worked beyond the point shown on the map. A gutter exists to the immediate north, but the gold values do not appear to have been sufficiently remunerative. The northerly continuation of this lead presents an interesting geographical problem. The present surface drainage of this area is to the east, while the course of the Thompson Lead here is to the north-west. The Lachlan Reef, however, which is barely covered by the alluvium, prevents it from getting through to the west, and it must have been deflected to the east at some point to the north of its present worked limit. Another lead, however, was worked to the north of this again, and which evidently entered the Thompson from the east, that is, its course is altogether against that of the present surface drainage. [This information has been supplied to me by Mr. Hasemer, of Forbes.]

Notwithstanding this, the former configuration of the country shows that the present Lachlan Reef, now buried under alluvium, must have stood as a ridge forming a valley wall of the Thompson Lead on the west, and the channel thus must have taken on an easterly course sooner or later. There thus remain two courses open to it. Either the Bald Hill Lead is the main channel, and the Thompson Lead is tributary to it, or the Thompson turns and has an independent course to the east before advancing so far north as the Bald Hill channel. It seems highly probable that the Lachlan Reef fed the Thompson Lead with gold in its passage northwards, and that the main drainage channel is the Bald Hills Lead, the Thompson being a tributary. In any case it would be advisable to put down a row of bores between the Bald Hill channel and the northern limit of the Thompson Lead.

The King Lead is supposed to have been worked in the early days for boom purposes. According to the statement of the late Mr. R. Barton, of Forbes, it was never remunerative.

The Queen's Lead.—The old workings known as the Queen's Lead lie about 8 miles north of Forbes. The ground had been occupied and abandoned in the early days of the field, because it was not continuously payable. About August, 1879, it was re-worked with such success that 300 men were soon on the ground. Many shafts were sunk, several of them bottoming at depths varying from 110 to 120 feet. The wash yielded from $3\frac{1}{2}$ to 8 dwt. a load. At the close of the year 1879 there were five parties on the lead, but the enforced cartage of the wash-dirt 4 miles to water, led to the temporary abandonment of the claims.

Towards the close of 1881 a shaft was sunk on the old No. 6 claim. Bottom was struck at 128 feet on hard slate; thence long drives were put in, and the width of the gutter was ascertained to be 25 feet, the wash being from 6 inches to 2 feet in thickness. While putting in these drives a large quartz reef, 3 or 4 feet thick, was discovered, but no gold was seen in it.

(b) Parkes Leads.

i. *The No Mistake Lead and its Branches.*

In 1871 alluvial gold was found 5 miles north-west of Parkes. This was at the head of the No Mistake, the first lead worked in the Parkes district. The lead was 2 miles in length, with a depth of as much as 120 feet. The

wash was about 12 inches in thickness. It was not the first discovery of gold, however, in the Parkes district, for in 1862 James Pugh had found the Pioneer vein immediately to the north of the present township.

Reid's Gully.—This is a narrow and crooked tributary of the No Mistake, discovered about the close of 1873. It has been traced for a distance of about 2 miles, and its upper course is separated from the No Mistake by a high ridge of schistose slate. After a course of about a mile and a half, it effects a junction with the No Mistake. At its head it is about 40 feet deep, gradually deepening to 97 feet at its junction with the No Mistake. Below the junction of the two leads a prospecting campaign was carried on during 1874. At a depth of 115 feet good prospects were obtained from a decomposed andesite. This lower lead, however, does not appear to have been as payable as its tributaries were. Both the No Mistake and the Reid's Gully leads were practically worked out before the close of the year 1880.

ii. The Bushman Group and its Tributaries.

The Bushman.—In July, 1871, Brogden and party discovered the rich alluvial lead known as the Bushman. This was on the present site of the Parkes township. Sir Henry Parkes visited the spot, and soon afterwards the name of the old village of Bushman was changed to Parkes. Brogden afterwards claimed a Government reward for the discovery of a payable gold-field, but it was proved that *James Pugh had discovered the payable Pioneer Reef nine years previously.

The Bushman Lead heads in a belt of crushed andesite, and at this spot is known as the Shallow Rush. It is from 15 to 20 ft. in depth. After crossing the Condobolin road it turns at right angles and parallels the same road until the town of Parkes is reached. The lead passes right under the centre of the town at a depth of from 75 to 90 ft. below the surface, and picks up the Little Bushman there. The depth of this tributary was as much as from 60 to 80 ft., and its wash-dirt was worth about 15 dwt. to the load. The lower course of the Bushman proper is known as the Great Northern, which, near the railway station, picks up the 'Possum Gully Lead. Another tributary is the Sardine Lead which effects a junction with the main channel near the crossing of the Billabong Creek by the Molong railway-line. These features are all shown on the general map accompanying the report. The Great Northern Lead proved a puzzle to the miners. It was followed to the Billabong Creek, and thence upstream for some distance. It then returned to the western side after a northerly course and entered a lagoon or basin, occupying a position about 92 ft. below the present land surface, and 70 ft. below the present creek level. The basin is of considerable extent, and it underlies a large portion of the western bank of the creek and extends thence across to the east bank. It contains wash-dirt from 2 to 7 feet in thickness. Many attempts have been made to work this basin, and to ascertain the continuation of the lead downstream, but such continuation has never been found. It is evident from the configuration of the country that it cannot continue its course up the Billabong for a great distance, but that it must turn downstream at a short distance only above the lagoon just mentioned. There are two courses open to it: Either it turns on itself shortly above the lagoon site and flows southward under the alluvium between the Billabong Creek and the Bartley Creek railway platform, or it

* Warden Sharpe's Report (Prospecting Board, 87/15730).

moved towards one of the gaps in the hills near the Molong road. The probable course of the deep lead is discussed, however, in the general Chapter devoted to the Leads.

iii. The Welcome Group.

This group consists of the Welcome, Tearaway, Frenchman's, Paddy's Flat, Little Welcome, Melbourne, and Fulton Leads.

The positions of these are indicated upon the map. The general appearance of the group in plan is similar to that of a branching tree. The main lead was discovered in 1872; then came the finding of the Tearaway in 1873, with that of the New Welcome, finally, in December, 1875.

The leads of the Welcome are shallow. At one time the Tearaway was supposed to be the main lead, and the "Old Welcome" Reef, situated on the Tearaway, derived its name from this circumstance. The main channel had a greatest depth of 140 feet., and at the point where it passed underneath the Billabong Creek it turned upstream. A great amount of prospecting was carried out along this portion of the lead, but the amount of wash-dirt was so large and the gold values so poor that the work was abandoned and has not since been resumed.

The Tearaway.—In 1873 this was called the Terrace. The channel is about 1 mile in length, and it was at one time supposed to be the head of the main lead, and for that reason the "Old Welcome" Reef lying alongside of it receives its name. The Terrace has produced large nuggets, some of which, found in 1874, weighed 7 oz., 25 oz., 35 oz., 37 oz., and 134 oz. respectively. In 1876 nuggets as large as 30 oz. were found. The depth of the gutter was shallow, rarely exceeding 20 feet. The lead is now practically worked out.

The Frenchman's Lead.—This tributary is about a mile in length and is situated on a slope separating Paddy's Flat and the Victoria Lead. It is shallow, rarely exceeding 12 to 14 feet in depth. The average value of the lead was from 3 to 4 dwt. of gold per ton of wash-dirt.

Paddy's Flat and the Yarran.—On the flat extending westward from the Tearaway is a short channel known as Paddy's Flat. The sinking here was about 80 feet and the channel itself is apparently a connection between the Yarran, the Frenchman, and the Main Welcome Leads. The Yarran is a short rich western feeder to Paddy's Flat.

The Fulton Lead.—This "run" is tributary to the Welcome, and enters it near the point where the latter passes underneath the Billabong Creek. Its depth is from 45 to 100 feet and the thickness of the wash-dirt is from 12 to 20 inches. It was not payable except in a very few places; six months after its discovery it was abandoned.

The Welcome itself has not been worked much below the point of intake of the Fulton, partly because of the very wet ground encountered, and partly because of the width of the gutter and the scattered nature of the gold contents.

The Fulton appears to be a continuation of the Nibbler's Lead.

The Melbourne Lead is a short tributary of the Welcome, entering it on the right bank and at a point situated a little upstream of the intaking of

the Fulton. It has a peculiar course, commencing in a flat near the Fulton, then turning at right angles and flowing parallel to the course of the Fulton. The Melbourne is practically worked out.

In 1891 Mr. J. E. Carne reported on an application for aid from the Prospecting Vote to continue the search for "the south-eastern extension of the Welcome and other leads which terminate close to the northern bank of the creek." (P.B. 91-3381). The site chosen by Drew and party as the scene of prospecting operations was C.P. 74-4396 of 320 acres on Billabong Creek, Ph. Mugincoble, and taken up by A. George. Mr. Carne stated that the Fulton Lead, which possessed a course almost east and west, was also supposed to cross the selection. "About 150 yards north-westerly from the present prospecting shaft is an old shaft which was put down some years ago, and a little gold was found at the bottom—127 feet. It is reported that this shaft was lost owing to a flood in the creek. At the time of my visit the present prospecting shaft was down 50 feet, the latter 30 feet in coarse drift, it was expected that the bottom would be reached at about 130 feet."—(J.E.C.) Fourteen shafts were sunk during the prospecting campaign, the depths being 52 feet, 147 feet, 149 feet, and 154 feet; 100 feet of driving was also carried out from the bottom of the 154 feet shaft. The attempt apparently was not successful.

iv. The M'Guiggan Group.

This embraces the M'Guiggan North and South.

The M'Guiggan has been perhaps the most important of the Billabong (Parkes) leads, partly because of its intrinsic value and partly because of the successful impetus it gave to prospecting operations in the Parkes district. In the early seventies many of the miners of the Parkes district went to the Palmer Field in North Queensland because of the local mining depression. On the 8th March, 1874, M'Guiggan and party, who meanwhile had been prospecting that belt of auriferous country which contains the Blue, Scrub, London, Victoria, New Haven, and Band of Hope lodes, obtained good gold in their shaft of 48 feet deep. Magnificent returns soon followed, and men flocked back from the Palmer, from Grenfell, and from other places, and by June of the same year the district had a population of nearly 10,000 people. M'Guiggan and party obtained their prospects at a depth of 48 feet. Thence for a distance southward for about two miles the lead was followed deepening as it went. The map shows its course. The deepest ground worked was about 160 feet, and the yields varied from about 3 dwt. to 3 oz. of gold per load. North of the Goobang Creek it was called M'Guiggan's North, but after passing underneath the creek it was called M'Guiggan's South.

In 1874 the best of the gold had been won from the M'Guiggan Lead, and at the close of 1875 only a few claims in the M'Guiggan's South were being worked. Almost without exception the leads of Parkes and Forbes had ceased to be payable on crossing the main Lachlan and Billabong streams, but the M'Guiggan South was an exception. For a considerable distance south of the Billabong Creek it was decidedly payable. Beyond a certain point, however, indicated on the map, the gutter became less defined; a "gilgai" appearance was developed in the channel drift; the gold became scattered; and after an expensive prospective campaign the miners gave up search for the continuation of the lead to the south.

The prospecting claims mentioned below, produced the following results :—

1. M'Guiggan's.....	2,140 oz. 4 dwt.,	value £8,625 18 0
2. M'Gee's.....	1,200 oz. 11 dwt. 19 gr....	„ £4,535 17 9
3. Cook	1,950 oz.....	„ £6,312 10 0

Besides these claims, others have given out great quantities of wash too, and permitted shareholders to clear from £500 to £1,000 each.*

v. The London Group.

This group consists of the London, the Little Wonder, the Sydney Clinker, and the All Nations.

The London heads from a zone of old and crushed rocks. It was opened in April, 1874, with the finding of payable gold prospects at 42 feet in No. 12. The lead itself was traced for a distance of nearly two miles.

The central claims were the only ones, however, which were payable; that is, the payable portion of the lead was confined to the limits of the claims No. 12 to 19. No 19 especially, gave splendid results. A peculiar topographic feature was revealed by the workings downstream of No. 19. At its head, the lead was 27 feet deep, and as far down as No. 18 even, the lead had not exceeded a depth of 75 feet.

At No. 20 it was 83 feet, but below No. 19 the ground showed a steep decline from 85 feet to 140 feet. No. 23 was from 175 feet to 200 feet deep, between limestone walls. Along the central ground the bottom had been shale and sandstone in benches, with bands and blocks of brown hæmatite. Here the ground had been payable.

Below No. 20 wash was plentiful, but almost barren of gold, although the metal was found scattered during sinking operations, although never in payable quantities. Many reasons were advanced to explain the poverty of the deeper ground. Among others, Mr. Wilkinson, the late Government Geologist of New South Wales, may be quoted in this connection :—

“Such not uncommon occurrences may have originated in various ways; for instance, at the particular time of the deposition of the gold-bearing drift, the old stream may have been wearing away, and distributing as drift, some auriferous bed-rock or quartz reef, which had no great depth; consequently, when the river had eroded its channel to a lower level, the underlying rock it then acted upon may have been non-auriferous, and therefore, the drift derived therefrom, would be so, also. Again, in Silurian country, there have been frequently noticed belts of non-productive rock, running parallel and alternating with rich tracts. These, then, under certain circumstances, would also afford an explanation of the above-mentioned facts.”†

As with the M'Guiggan Lead, so with the London, a deeper channel runs parallel to the lead, but its wash does not appear to have been payable. In some of the claims along the London, a consolidated drift or cement was found, and this proved to be as rich as the ordinary wash-dirt. Boulders were frequent in the wash between the claims from No. 14 to 19, and these consisted entirely of nodules and blocks of a compact rich iron ore.

Another peculiar physiographic feature is the existence of a channel downstream of No. 21 claim. In No. 20, bottom was found at 83 feet, but another channel passes underneath this again, at a depth of 170 feet. In the

* Ann. Rept. Dept. Mines N.S. Wales for 1876, p. 85.

† C. S. Wilkinson, Mines and Mineral Statistics N. S. Wales, 1875, p. 121.

latter, a poor river wash about 8 feet thick, was found. The existence of this main stream channel had long been known, as it was discovered on the opening of the London Lead. It had also been found to cross the Ben Nevis Lead half a mile further to the west.

The tributaries of the London are the Little Wonder, the Sydney Clinker, and the All Nations. These are all short in length. The Little Wonder effected a junction with the London at No. 15; its depth was from 70 to 90 feet, its channel crooked and narrow, and it was very rich in places. The Sydney Clinker and the All Nations, however, were never remunerative.

Although the London Lead has been worked intermittently almost up to the present, nevertheless it was practically worked out in 1880.

vi. The Tichborne Group (Tichborne, Fairy, and Wapping Butcher).

The Tichborne.—This lead was discovered early in July, 1874. Geographically and chronologically it falls into the group of leads, of which the Ben Nevis, London, McGuiggan's, and Wapping Butcher are members. Murray and party were the first to hoist their flag over this lead and to report payable gold. This was in the vicinity of Tom's Knoll, or what is now known as Miller's Hill,

The Tichborne lead, one mile east and one mile west of the prospecting area, was then declared. The claims or areas on the eastern line were afterwards found not to be of the expected depth, the frontage system on that portion of the lead was then abolished, and the system of block claims instituted. The prospectors' claim exceeded 100 feet in depth. The block claims to the east varied from 72 feet at the head to 90 feet by the prospectors, and the wash varied in thickness from 2 feet to 17 feet. The frontage areas to the west deepened from 106 feet in No. 1 to 130 feet at No. 11. Beyond this point towards McGuiggan's South the depth was still greater.

The channel of the Tichborne is somewhat deeper than that of the Wapping Butcher, which appears to be tributary to the former. The wash also is finer in the Tichborne, and contains more clay and sand, as well as a smaller number of boulders. The course of the lead is crooked, and the channel varies in width, the under portion being 100 feet. The wash varied from 3 dwt. to $1\frac{1}{2}$ oz.

The original prospectors shared the fate common to pioneers. They obtained their prospect of 2 dwt., and no more; sank and drove 1,200 feet, and after eight months labour, and having defended two actions initiated by jumpers, abandoned the ground. Below the prospectors down to No. 9 frontage the claim yielded little more than wages.* Many of the leads were rich, those to the east being almost uniformly so.

The Frenchman's Block (East) had 17 feet thickness of wash, and from 5,000 loads four shareholders realised £5,000.

From No. 6 (East) Mooney and party realised £900 a man. 100 oz., 120 oz., 150 oz., and 250 oz. of gold were obtained from trial washings in four eastern claims. From No. 6 (East) McCann and party won 1,700 oz. gold during 1875.

It has been mentioned already that the claims taken up to the south-west of the prospectors' were not nearly so rich as those to the east of this claim.

* Ann. Rept. Dept. Mines N. S. Wales for 1875, p. 34.

Of 19 frontage holdings only six were payable, and no well-defined lead was discovered. Indeed, the lead was believed to have been worked out by the end of 1875. Another attempt, however, was made in the latter half of 1879 to prove the supposed continuation of the Tichborne with the South M'Guiggan Lead. At that date McClelland and party took up a prospecting area near No. 11, M'Guiggan's South, and struck an auriferous wash 12 inches to 18 inches thick and 25 feet wide at a depth of 123 feet.

A clearly-defined channel was found with a south-westerly course. Fine sand and boulders, similar to those occurring at the head of the Tichborne, was passed through. The wash also was of the same description. The prospectors drove north, south, east, and west. Eleven loads were washed, and yielded returns at the rate of 6 dwt. 12 gr. per load. This claim turned out to be quite payable, and four other parties rapidly took up claims over the lead. Some of these produced payable gold. This claim was within a short distance of No. 10 on the Tichborne, and it is thought that the two leads, the Tichborne and M'Guiggan's South, are connected.

Fairy Lead.—This heads in Miller's Hill, and has a northerly course before it joins the Tichborne Lead. Two series of auriferous gravels were found, the one a shallower and a heavier deposit than the lower one. The lower one, about 50 feet in depth, was not as payable as the upper one. The shallower deposit was overlain by about 15 feet of very fine red sand. The whole lead was short, but payable, but it is supposed to have been worked out. One claim produced £2,000 worth of gold, and three other claims each produced gold to the value of from £1,200 to £1,800.

The Wapping Butcher.—This lead has a northerly course, and is tributary to the Tichborne. It was found in the latter part of 1874, immediately after the discoveries of the Tichborne and M'Guiggan's South, and just prior to the finding of the Fairy and Fulton Leads. According to Mr. Warden Dalton,* the Wapping Butcher was a continuation of the Fairy Lead, "both following the summit of a ridge of palæozoic rocks, that, at a depth below the surface varying from 45 feet to 72 feet, extend to the northward." From a study of the map, however, it seems probable that both the Wapping Butcher and the Fairy Leads are independent tributaries of the Tichborne Lead, the one entering from the north and the other from the south. The ridge of underlying rocks, along the top of which the Wapping Butcher and the Fairy Leads flowed, appear to have been notched in its central portion. In this deepest position the alluvium was 72 feet deep, while to the north and south the ground gradually became more shallow, until it was 54 feet deep on one side and 45 feet on the other. One hundred yards to the east of the Wapping Butcher the alluvium of the plain becomes much deeper, and consists of clays and gravel. It would thus appear that the channels of the leads we are considering are of later origin than the channels existing, just at the commencement of the subsidence, which resulted, finally, in the formation of the broad alluvial plain of the Billabong Creek.

At the base of the Wapping Butcher channel large quartz boulders were encountered, some too large to move without the aid of blasting. With these boulders were associated pebbles, red, brown, and white clays, and blocks of conglomerate.

Locally, these fragments of conglomerate were known as clinkers, and, with the exception of the cement, they were similar in character to the loose wash. It is interesting to note that solid nuggets of water-worn gold have

* Ann. Rept. Dept. Mines N. S. Wales for 1873, p. 32.

been frequently obtained from them. "The clinkers at the . . . Wapping Butcher . . . are crystallized, some exquisitely shaped. . . . The largest piece of a clinker at the Wapping Butcher was 9 feet high. At the Wapping Butcher and Tichborne Leads these bodies contain gold *in situ*. From one weighing 3 lb., 3 oz. of gold were obtained; from another, $1\frac{1}{2}$ oz., and so on. They are, inside, pure white, with rarely very slight external colouring. These crystallized clinkers prove most obdurate, defying the pick and the gad."*

The lead varied from 45 feet to 70 feet in depth; it was about a mile in length; the wash being from 1 foot to 16 feet in thickness; and the channel was as much as 200 feet wide in places.

The northern end of the Wapping Butcher was never satisfactorily determined. It has been thought that the Growler's Lead (see map) is its continuation. Another idea was that the Fulton either represented a tributary to the Wapping Butcher or was its actual continuation. In any case, a great amount of prospecting has been done to the north of the supposed junction of the Growler's with the Wapping Butcher.

A section of the alluvium, as exposed in a shaft on a claim worked by W. Jones and party, gives a fair idea of the nature of the sinking on the lead. The claim was 220 feet square, and situated on alluvium in the midst of a dense pine scrub, and gave no indication of a buried watercourse below.

The beds passed through were:†

Chocolate soil	...	...	...	...	..	4 feet
Yellow striated clay, mixed with quartz gravel	...	...	...	...	...	10 "
Quartz gravel	...	...	...	...	...	4 "
Partially decomposed conglomerate of quartz gravel, pebbles, and boulders, mixed with fragments of ironstone, igneous and transmuted rock and various slates and shales	...	...	...	...	...	20 "
Coarse red and brown sand and drift	...	...	...	...	...	12 "
Auriferous drift apparently derived from the base of the conglomerate	...	...	...	...	...	4 "
Total	..	...	...	...	...	54 feet

The greater part of the conglomerate was disintegrated, and the majority of the pebbles, with the exception of the quartz and silicified fragments of schist, were altered to clays of various colours, the clay pebbles being in many cases reconsolidated by an infiltration of lime and iron. Where the lime and iron had not been removed large blocks of the conglomerate remained in their original state. These masses were known locally as clinkers. The base of the conglomerate-like drift often forms the auriferous wash in this part of the field.

The sinking operations in the claim of Murphy and party were through:

Brown soil	...	...	...	...	...	5 feet
Sand and drift	...	...	...	...	...	5 "
Friable red clay	...	...	...	...	...	30 "
Coarse gravels	...	...	...	...	...	2 "
Chocolate coloured friable clay	...	...	...	...	...	10 "
Conglomerate...	...	...	...	...	...	3 "
Total	...	...	...	...	...	55 feet

* H. Murcules, Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 83.

† Ann. Rept. Dept. Mines N. S. Wales for 1875, p. 33.

The Wapping Butcher Lead was short but very rich. A trial washing of 46 loads from one of the claims yielded 109 oz. of gold. In 1875 Carroll and party took out 1,200 loads for 1,600 oz. of gold from a small claim 220 feet square. Bowes and party, from a similar area, obtained £4,000 worth of gold. From the claim of Jones and party, just described, a washing of 1,005 loads yielded 2,707 oz. of gold. Only one third of the claim had then been worked. From an adjoining claim a nugget weighing 26 oz. was obtained. In the same locality, Kenna and party obtained $1\frac{1}{2}$ oz. per load, Francis and party 1 oz. per load, Murphy and party, 3 oz. per load, also cement with fine results, and nuggets up to 20 oz., McFadden and party, 2 oz. per load, and Williams and party, 3 oz. per load. Farrell and party 2,200 loads for a yield of 1,543 oz., many nuggets being 5 and 6 oz. each, the largest being $16\frac{1}{2}$ oz. Messrs. Barlow and party, 600 loads for 450 oz. The "cement" was also rich in places, sometimes yielding results when crushed as high as $2\frac{1}{2}$ oz. per ton.

vii. Ben Nevis Lead.

This lead has never been very remunerative although it has been well prospected. It heads in a mass of schistose slates, tuffs, and andesite flows. It was opened up in March, 1874, and was worked for a distance of from one and a half to two miles, but it was practically deserted in 1875.

The lead was narrow at the head but it widened out downstream. The bottom descended suddenly * from a depth of 25 feet to one of 120 feet in less than half-a-mile; then again it ascended as suddenly to a depth of less than 100 feet. A belt of amygdaloidal basalt, known to the mines as "Tertiary bottom," is said to have crossed the lead from north to south.†

An interesting feature in connection with this lead is the thick accumulation of clays and the depths of the channel at isolated spots. Thus, on the ground known as No 2 North, Messrs. Frampton and party sank a shaft to a depth of 204 feet of which 117 feet was through clays. The clays were yellowish and impregnated with minute crystals. Occasional layers of gravels, sandstone boulders, sand, and belts of auriferous river wash were passed in sinking the shaft, the gold being fine and not in payable quantities. At a depth of 204 feet a layer of fine white sand was met and subjacent to this lay an indurated limestone, which gave off an unbearable odour. Auriferous drift was also found at this depth. Frampton believed that 20 feet more of sinking would have proved the ground, but the patience of the party had been exhausted and the claim was abandoned.

viii. The Scrubby Plains.

This is a portion of the alluvial plain of the Billabong Creek, near the village of Tichborne.

On the plain, which is practically devoid of watercourses, the surface gives little or no indication of the buried stream channels, hence the difficulties which arise when prospecting this ground.

Examples of such buried channels are the Welcome, the McGuiggan, the London, and the Tichborne, which, as they passed under the alluvial cap proper, were traced only with difficulty. As a result of these rich finds,

* Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 83.

† *Ibid.*, p. 83.

indiscriminate prospecting ensued over the whole area in the hope of locating defined channels. About a mile and a half from the lowest points yet worked, downstream along the leads just enumerated, four small block claims were taken up on a channel, which evidently formed part of a lead. From a depth of 54 feet, these claims produced about £50,000 worth of gold.* It was found impossible to connect this channel with any known lead, although many experienced miners believe such connection does exist.

In March, 1876, Dunlop and others reported payable gold at 135 feet deep, about three miles south-east of the Tichborne Lead. The prospectors' claim being unpayable, however, they abandoned the place.

For a period of two months, in 1876, Messrs. Duke and party tested that part of Scrubby Plains, which lies about one and a half miles south of the McGuiggan Lead, one and three quarter miles from the southern bank of Billabong Creek and not far distant from a reef prospected by Cotton and party. Shafts were put down in a line, with depths varying from 10 feet to 40 feet, from 60 feet to 82 feet, and from 83 to 95 feet. From the bottom of one of these they drove 140 feet. Plenty of "river wash" was obtained and fine gold was found, but the ground did not prove to be payable. Hundreds of miners were shepherding alongside, but none attempted to sink, and finally Duke's party abandoned the ground. "Had the ground there been held under the frontage system, the width allowed by it constituting some security to miners for work expended, many shafts below and above the prospectors' would have gone down and thus the locality would have received a proper test."†

It has been thought by the mining community that this deep ground may not have been as valuable as the more shallow gutters, which doubtless exist in the neighbourhood of the deeper ones. In this connection it may be noted that about eight leads, each from 1 to 3 miles in length, had been traced on the northern bank of the Billabong Creek and had been worked to the edge of that stream, where, at 70 feet below the base of the present channel, auriferous wash had been found. To the south, all search for them proved more or less unavailing, with the notable exceptions of the Tichborne, the Wapping Butcher, and the McGuiggan South.

In 1885, Mr. Wilkinson, the late Government Geologist, visited the Scrubby Plains in connection with a prospecting campaign, and the following note was made by him on that occasion:—

"Some of the prospecting shafts on Scrubby Plains reached a depth of 161 feet, passing through yellow ferruginous and white sandy clays, pipe-clay, and a little quartz-pebble drift, partly cemented with ironstone and containing colours of gold; the bed-rock is Silurian slates with quartz veins."‡

Later again, in June, 1886, a rather extensive rush took place to the Scrubby Plains, when 450 miners were on the ground at one time. Prospecting was carried on with Government aid and the prospectors reported that payable gold had been discovered by them. The depth of the shaft was 56 feet, the wash being from 3 to 9 inches in thickness. The attempt, however, proved to be unsuccessful.

* Ann. Rept. Dept. Mines N. S. Wales for 1878, p. 71.

† Ann. Rept. Dept. Mines N. S. Wales for 1876, p. 87.

‡ Ann. Rept. Dept. Mines N. S. Wales for 1885, p. 127.

ix. *Minor Leads.*

The Victoria.—The lead of this name heads in the same mass of crushed slates and allied rocks as the London and the Ben Nevis. The country associated with the lead contains numerous gold-bearing lodes.

The lead was short and unimportant; its depth was 14 feet, and the thickness of the wash dirt was from 6 to 18 inches.

Magpie Lead.—The finding of the Magpie Lead was the result of an attempt to prove the alluvial ground to the south-east and the south-west of the leads near Tichborne. Geographically, the country tested is a southern extension of the Scrubby Plains. The prospectors obtained good results; a rush set in, and 200 men came on to the ground immediately. This was during the commencement of 1879. For two months the men prospected the ground, but without success. The depth of the ground was from 90 feet to 130 feet, the thickness of the wash from 6 to 12 inches, the bottom a series of gilgais, from the sides of which the prospects were obtained. No well-defined channel was ever found. In spite of this failure the majority of the miners were of the opinion that a payable "run" of gold existed in the locality.

"In sinking upon the plains to the south of the Tichborne, in various parts, the result has been always the same as on the Magpie Rush, gold, but not in payable quantities."*

Nibbler's Lead.—This short gutter was discovered early in 1874. It is either tributary to, or is the head of the Fulton itself. The depth was from 25 to 30 feet, and the wash was about 12 inches thick. The prospecting claim yielded 1 oz. of gold per load. A little fossicking is still carried on at various times.

The Growlers' Lead is short, and was discovered in 1874; its channel is narrow and difficult to follow. The depth is only 14 feet. Two of the claims yielded as much as 18 dwt. of gold a load, but the remainder yielded wages only.

The Well Tried Lead.—This heads in the same belt of country as the M'Guiggan. At its head it consists of surfacing. It is a long, shallow gutter, which has been almost completely worked out.

The Secrets Lead is situated about six miles to the north-west of Parkes, near the Bulgaldramine-road. The date of its discovery was 1901. The depth of the sinking was about 90 feet, and the yield was about 4 dwt. of gold to the load. Many claims were taken up, but the only payable one was the prospectors'.

B.—THE LODES.

(a) Forbes.

i. *The Lachlan Line of Lode.*

The notes on the discovery and prospecting of the Lachlan Lode (and its northern extension comprising the Nil Desperandum, the North Lachlan, and the Federal) have been supplied by Mr. J. S. Sanderson and Mr. J. O'Shanassey, formerly assayer and underground manager respectively of the Lachlan Mine. The notes on the progressive development of the lodes subsequent to 1897 have been obtained from the Annual Reports of the Department of Mines for the years 1897 to 1909.

* Warden Dalton, Ann. Rept. Dept. Mines N. S. Wales for 1879, p. 90.

The "Lachlan" Lode was formerly known as "Sinclair's Reef." It outcrops only as a small ironstone mass, the remainder of the long line of lode being completely buried beneath a wide alluvial terrace. Its existence was inferred from the occurrence of—

- (1) "Leads" which had been traced upstream towards the position occupied by the lode.
- (2) An ironstone outcrop about 3 chains south of the present main shaft on the reef.

With this evidence Sinclair and party decided to sink on the ironstone. During the prospecting operations the ironstone was found to be associated with andesites, both porphyritic and felsitic in appearance. These andesites in turn were observed to intrude sedimentary rocks. The latter had been much altered by mountain-making forces. Claystones had been changed to silky slates; individual fragments of breccias had been drawn out into augen-structures, and even at times into thin parallel plates of graphitic slate. The lode itself was found to have commenced as a quartz deposit formed in open fissures between the andesite dyke and the altered sediments. Where prospected the lode was about 4 feet wide, but it was soon ascertained that large lenses of ore were associated with the fissure. Thus the "Cellar," which was opened up near the 150 feet level, represented one of these lenses, and was from 20 feet to 30 feet wide, 100 feet long, and 50 feet deep. Other large lenses occurred both in the Lachlan Lode itself and in its northern extension known as the North Lachlan. In all these instances the enlargement of the ore bodies appears to have been due to replacement agencies. The underground workings of the lode were not accessible to the writer in 1909, because all mining operations had been suspended; nevertheless, from the samples of ore and gangue lying about on the surface the conclusion was inevitable that a great percentage of the ore masses had been due to the replacement of country by the action of heated waters. Networks of tiny fissures were first developed, which were filled with silica and various sulphides. From these tiny veins a gradual alteration of the intermediate areas took place, until complete replacement had taken place at certain favourable situations, while at others the silification progressed only to such a degree that the country between the veinlets appears now as a mass of breccia. All gradations from networks of veins in, to complete replacement of, the country may be seen. This throws an important light on the origin of the "breccias" so frequently found in mines where the individual fragments of the "breccias" are not in contact with each other. It would be interesting to examine them in the light of the possibility that they represent a minor phase of replacement by quartz, calcite, or other minerals acting from networks of tiny fissures. The Eleanora Reef, of Hillgrove, appears to be a case in point. The associates of the gold, besides quartz, are calcite, iron, and arsenical pyrites. In the upper portions of the lode the pyritic content has been frequently leached out, leaving cavernous or honeycombed quartz, which merges gradually into the pyritic zone at depths of from 150 feet to 230 feet. Water level, according to Mr. O'Shanassy, occurs at about 75 feet. The hanging wall is of slate, the footwall of andesite; the footwall is well defined.

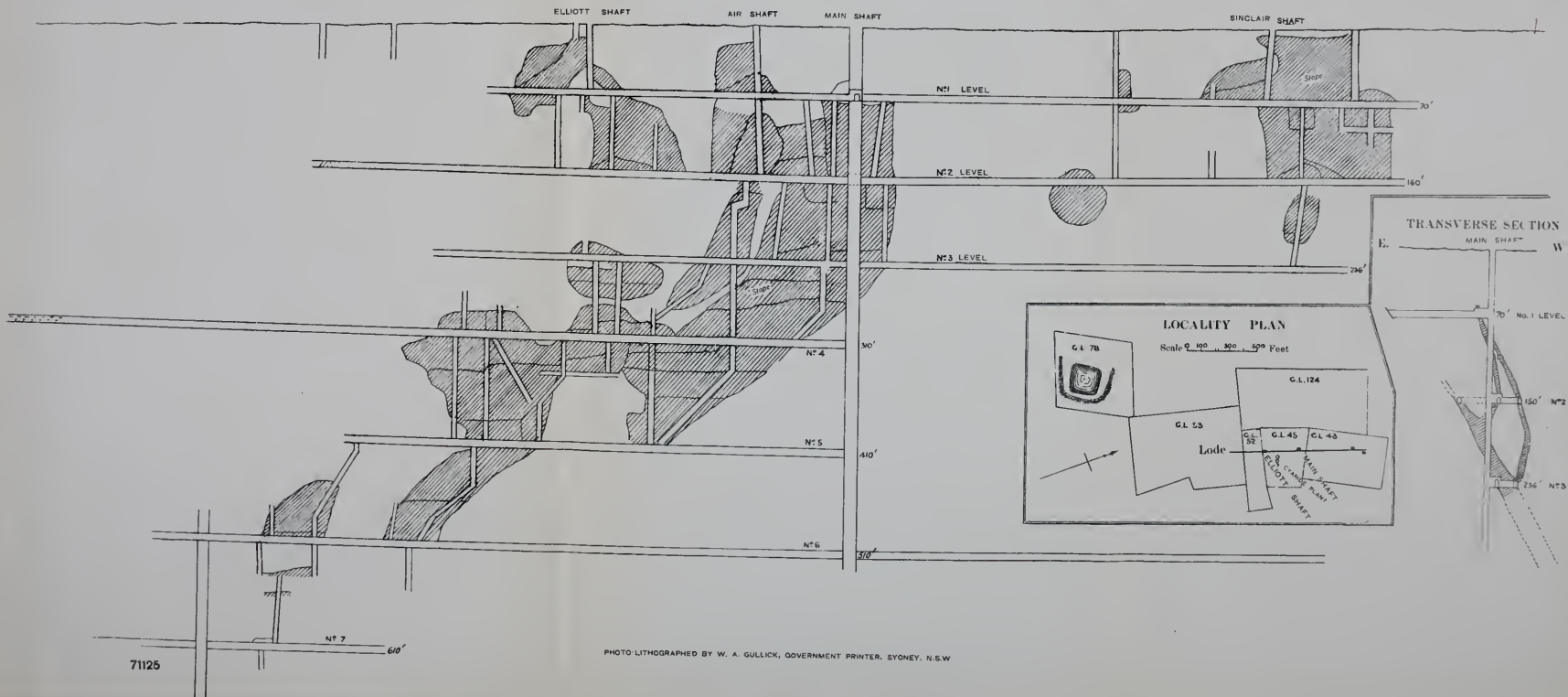
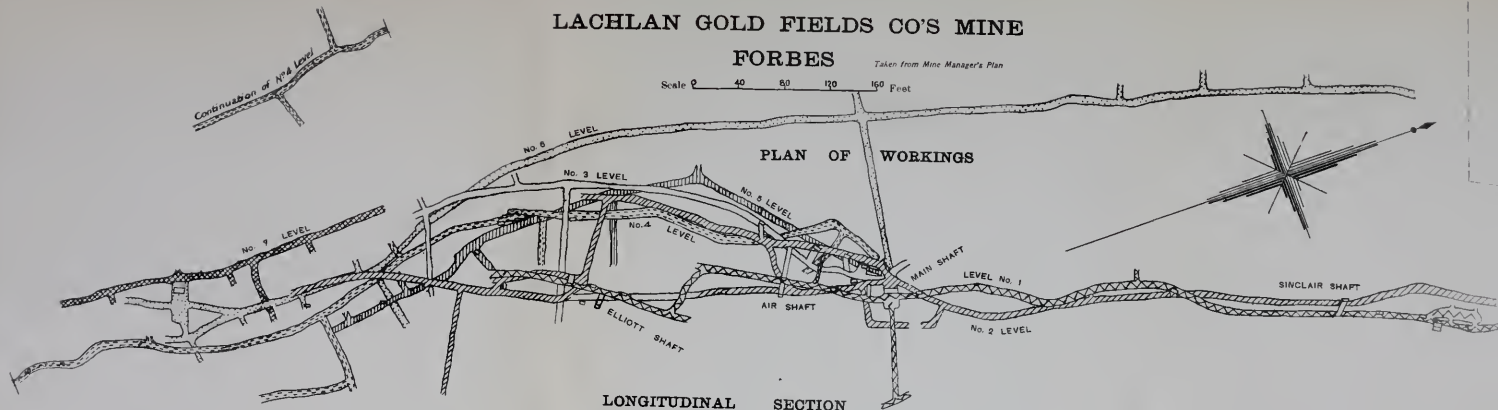
The original prospectors of Sinclair's Reef found stone varying in value at the surface from 5 to 16 dwt. Two whip shafts were then put down, and shortly afterwards the mine was floated into a company, with 75,000 £1 shares.

PLAN AND SECTIONS OF THE LACHLAN GOLD FIELDS CO'S MINE

FORBES

Taken from Mine Manager's Plan

Scale 0 40 80 120 160 Feet



According to Mr. Sanderson, the very large large lens of stone known as the "Cellar" yielded about 15 dwt. per ton.

At a depth of 230 feet the sulphides in the stone varied in value from 15 dwt. to 1 oz. of gold per ton.

The following notes are based upon information contained in the various records of the Department of Mines. Possession of Sinclair's Reef was taken on 28th August, 1896, and a survey of the lease was made on 10th October, 1896.

In 1897, "The Lachlan Gold-fields Company (Ltd.)" was formed to work the lode. The main shaft was then down 80 feet and had reached water level. Three other shafts had also been sunk to the same depth, and 800 feet of driving had been done. Two dams, each of 5,000 cubic yards capacity, had been made, and a battery of ten head stampers was in process of construction.

In 1898, from 70 to 80 miners were employed. The main shaft had been sunk to 160 feet. At the 70-foot level the lode had been followed for 900 feet, and at the 150-foot level for 400 feet. Along these workings the lode was found to vary from a few inches to 9 feet in width. The water came in at the rate of 1,300 gallons an hour. A ten-head battery, with ore bins and automatic feeders, was erected, and connected with the main shaft by a tram-line. The tailings amounted to 130 tons a week, for the treatment of which three 30-ton leaching vats, two sump vats, two solution vats, and two zinc extractor boxes had been erected.

About 3,500 tons of ore were treated at the battery during the year, 1,700 tons of tailings at the cyanide plant, and about 900 tons of slimes were accumulated for future treatment. In all, about 2,088 oz. of gold had been won since the opening up of the mine.

One result of this success was the leasing of the ground to the north along the line of the lode, and the commencement of a determined prospecting campaign. In one lease, known as Morris', which adjoined the Lachlan Gold-fields property to the north, a shaft, commenced in February, 1878, was put down 105 feet, and a drive put in 200 feet to the north during the year.

In 1899, a main shaft (10 feet by 4 feet), had been sunk to a depth of 230 feet. Long levels had been run at the 70-foot, 150 foot, and 230-foot levels.

The vein was found to be of irregular nature width, being 22 feet across at the widest part. The water in the mine was saline, and came in at the rate of 1,500 gallons per hour. The cyanide plant had been improved, and during this year consisted of three (20 ft. x 3 ft. 6 in.) sand vats, and two (20 ft. x 4 ft.) slime vats; 450 tons of sand, and 150 tons of slimes, were treated a month. During the year, 5,613 tons of stone were treated for 4,287 oz. of gold.

During the year 1900, the main shaft had been carried down to a depth of 312 feet.

In 1901, the main shaft, which is situated 60 feet east of the lode, had been carried down to a depth of 390 feet. A new level was run at the 310-foot level. At a depth of 150-feet a drive had been put in 1,000 feet on a massive lode. Along the 310-foot level (240 feet in length) the lode averaged from 15 feet to 18 feet in width. It had now been proved for 1,800 feet, that is, along the whole length of the property. Along the lower levels so far worked the vein material consisted of a hard bluish quartz, averaging from 15 to 30 per cent. of pyrites. Amalgamation, concentration, and

cyaniding were the methods employed in the extraction of gold. The concentrates were sold to smelting works. About one-third of the gold was recovered by amalgamation, one-sixth by cyanide processes, and one-half by concentration.

The main shaft was carried down to 420 feet during the year 1902, and a drive was run for 320 feet at the 410-foot level. The lode was ascertained to vary in width from a mere knife-edge or thread to 42 feet. Near the surface it had been split up into smaller lodes, but at the deeper levels these minor veins coalesced to form one large lode. 7,192 tons of stone were raised this year for a yield of 5,542 oz. of gold, of a value of £22,103.

Eighty-seven men were employed in this mine in 1903, and the shaft was carried down to a point 499 feet below the surface. More development work was carried on during this year at the 310-foot and 410-foot levels. A variation in metallurgical method was also adopted. The pulp from the battery, after treatment over amalgamating tables and over concentrators, was further pulverised in pans and subjected to a second concentration. 5,872 oz. of gold, valued at £24,882, were won during the year, and the value of the machinery at this period was £10,634.

In 1904, Mr. J. B. Jaquet, the Chief Inspector of Mines, reported as follows upon this reef:—"The main lode occurs along a contact between augite-andesite and slate, the ore bodies varying greatly in thickness. In the Lachlan Gold-mine a dyke (?) of felsite has been intruded between the augite-andesite, and ore has been found upon either side. As proved by a cross-cut at the 510 feet level, this felsite dyke is 110 feet in width. The larger ore body occurs along its line of juncture with the slate, and one of lesser importance, and which has yet to be prospected, where it junctions with the andesite.*

During the year the main shaft was sunk to a depth of 520 feet; at 510 feet a level was put in; a cross cut was run; and driving north and south of the shaft along the lode was carried out. Payable stone was found along this level.

Drives north and south of the main shaft, at the 510-foot level, were run in 1905, until a total length of 1,129 feet had been reached. In all 1,712 feet of driving and rising were done this year. Good payable stone was reported along the 510-foot level. Nine horizontal bore holes, totalling 716 feet, were put in from the underground workings with satisfactory results.

During this year the cyanide process was done away with, and recourse was had to a more careful method of concentration, so as to save the sulphide tailings. A "Card table" and a canvas table plant were added to the machinery, the whole plant this year being valued at £11,427.

Again, in 1906, about 1,269 feet of sinking, driving, and rising were carried out. The main shaft was carried down to 610 feet; thence the lode was driven on for 293 feet. At one point along this lowest level the lode was 35 feet wide, but of poor quality. During the year crushing, amalgamation, and concentration were resorted to, the tailings being ground in Watson and Denny pans, and re-concentrated. A new plant, comprising a roasting furnace and cyanide vats, was erected.

In October, 1906, mining operations were temporarily suspended, and during the period of subsequent inactivity, the plant was used for treating the heaps of sulphide tailings lying about the mine.

*Ann. Rept. Dept. Mines N. S. Wales for 1904, p. 66.

The Lachlan Gold-fields Mine was worked at a loss during 1907—424 oz. of gold only, valued at £1,926, being won. The return from the treatment of 1,187 tons of sands was included in the 454 oz. just recorded. In August of this year mining operations were again suspended.

In 1908 very little work was done on this property, 572 oz. of gold only being won, valued at £2,071.

The company was wound up this year (1908) and its assets realised. The same year the Forbes Gold Recovery Company won 146 oz. of gold, valued at £585, from cyanidation of the tailings of the Lachlan Mine. Up till the end of 1909 this company has won 887·17 oz. of gold from cyanide processes.

A plan of the mine is herewith reproduced, showing the amount and nature of the work done, and the pitch and width of the shoots of ore. According to Mr. Sanderson (Assayer) payable stone probably still exists in the south end of the mine, while according to Mr. O'Shanassy (Underground Manager) mining operations were left off on stone of the value of from 12 to 16 dwt. per ton.

ii. *The Nil Desperandum Lode.*

In 1898, Morris and party sank a shaft 105 feet deep on the Lachlan Lode, immediately north of the Lachlan Gold-fields' Lease. This party also drove 200 feet along the lode and found gold. A considerable depth of alluvium had to be sunk through before reaching the vein. The lode has been proved the whole length of same, a distance of $23\frac{1}{2}$ chains.* "Prior to the formation of this company various shafts had been sunk on the lode, down to 90 feet, the water level, and in each shaft gold was obtained, assaying from 2 dwt. to $2\frac{1}{2}$ oz. per ton. When the various leases became the property of the company, and were amalgamated, it was decided to sink a main shaft west of the lode so as to reach it at a depth. At the present time the main shaft has been sunk 217 feet, the dimensions being 10 feet by 3 ft. 6 in., with three compartments—pump and ladder shaft and two hauling shafts—and is centred throughout its whole depth. At the 110-foot level a chamber has been cut to open east on the lode, and at the 207-foot level a chamber was opened west. A drive is being put in north from the 230-foot level along the lode. This will connect with what is known as Hollinger's Shafts, at a point 200 feet from the main shaft, and also provide ventilation. Different assays taken from the drive at the 200-foot level have given from 2 to 25 dwt. per ton. In Hollinger's Shaft there is a lode 7 feet wide at the 90-foot level."

The footwall was andesite and the hanging wall was slate. The lode had a western underlay and a strike of about 20° E. of N. The lode was proved in 1902 by the sinking of prospecting shafts along the line of lode for a distance of about 50 chains. In one shaft, namely, that near the southern boundary the lode was cut at a depth of 115 feet. A considerable amount of driving north and south was carried on thence, at this place it averaged 7 feet in width and assayed from 5 to 20 dwt. of gold per ton.

In two other shafts, still farther to the north, the lode was cut at a depth of 90 feet in each case. At these points the lode varied in width from 3 to

* Ann. Rept. Dept. Mines N. S. Wales for 1901, p. 21.

12 feet and assayed 15 dwt. per ton. The main shaft was down 217 feet at this time, and from the cap of the lode to a depth of 150 feet a ferruginous quartz was met with, which at greater depth made into sulphides. In the drives, which were run north and south at the bottom of the main shaft, a lode varying from 9 feet to 12 feet wide was proved, the assays varying from 5 dwt. to 2 oz. per ton. A ten-stamper battery was erected and Wilfley and concentrating tables and other necessary appliances were installed. A tank of 5,000 cubic yards' capacity was excavated as well as two salt-water tanks of 800 cubic yards' capacity each. A company was formed of 256 shares of £25 each, and £3,630 had been spent on the mine before the company was floated.

In 1903, the Nil Desperandum Gold-mining Company employed about forty men, and the estimated value of the machinery on the 46-acre lease was £5,840. The main shaft had been carried down to 300 feet; 170 feet of cross-cutting, 581 feet of driving and 360 feet of rising had been carried out, and a winze sunk 40 feet. The plant in this year consisted of twenty head of stamps, a concentrating plant which consisted of four percussion tables, two Wilfley tables, two Watson and Denny pans, and a 15-foot elevating wheel for lifting the sands. The total amount expended on the mine and plant until December, 1903, was £15,600. In this year 1,170 tons of stone were raised for a return of 315 oz. of gold valued at £1,100, being 175 oz. by amalgamation and 140 oz. by concentration.

In 1904 the main shaft was carried down to a depth of 420 feet; 453 feet of driving, 135 feet of cross-cutting and 240 feet of rising were also carried out during the year. Developmental work was done mainly, and no crushings were made for nine months in the year. Good sulphide ore was reported from the 400-foot level south. A width of stone here of from 6 to 14 feet was met with, an average assay value of 14 dwt. A large amount of gossan ore, reported to be worth 10 dwt. per ton, existed in this mine in 1904.

The company proposed to erect both an Edwards roaster and a cyanide plant.

In 1905, 1,689 tons of stone were treated for a yield of 693 oz., valued at £2,272. On the 10th of December the mine was closed for reconstruction, and since that date no work appears to have been done on this lease.

iii. The North Lachlan Lode.

The existence of the lode of this name was foretold by alluvial miners who had been working along the Bald Hill Lead. In tracing the latter to the west the ground became more shallow, and the presence of a feeding lode was suspected. The lode when exposed exhibited features similar to those possessed by its continuation to the south known as the Nil Desperandum and the Lachlan. It has been determined by an intrusion of andesite into schistose slates, and replacement of country by lode material is a characteristic feature. Large chambers of ore have thus been formed, which are decidedly of pyritic nature below water level.

The following sketches from measurements supplied by Mr. A. L. Brain illustrate both the general appearance of an ore chamber and the general relations of the ore to the country :—

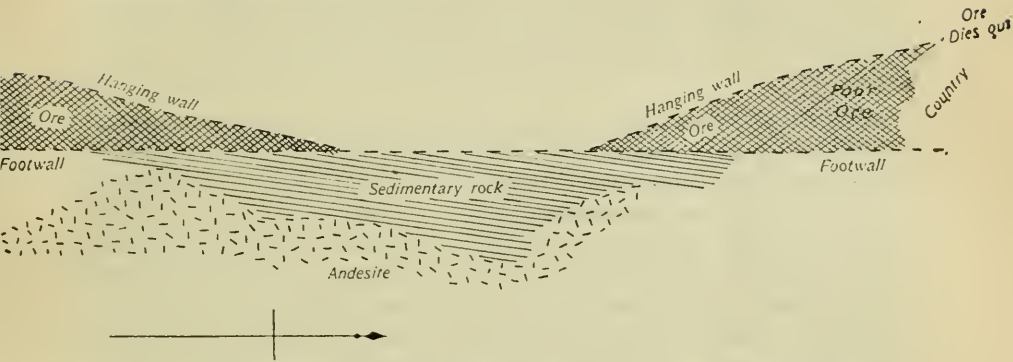


FIG. 7a.—Ideal plan showing association of lode and country at one spot in the North Lachlan Mine.

"In 1901 an area of 30 acres was leased along the Lachlan Lode immediately north of the leases belonging to the Nil Desperandum Company. This lease embraced 2,870 feet along the course of the lode. During the same year a considerable amount of prospecting was done, and the assay values contained were considered very satisfactory. A main shaft was sunk to a depth of 127 feet, and at the 87-foot level, a cross-cut, which was put in opposite to the shaft, proved the lode to be 14 feet wide at that point.

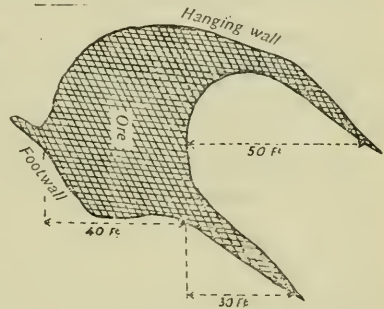


FIG. 7b.—Section across large ore lens in North Lachlan Mine; based on measurements supplied by Mr. A. L. E. Brain.

"In May, 1902, mining operations were commenced by a London company, known as the Hauraki Gold-mining Company. Their leases were 45 acres in extent. Previously to this a syndicate of local shareholders had prospected the lode. By them it had been developed to a depth of 20 feet, at which point heavy water had forced them to discontinue work. The new company immediately set to work to prospect the whole course of the lode which ran through the leases, a distance of 2,870 feet along its strike.

"A 20-horse-power double cylinder hoisting engine, with double winding drums, has been erected, and substantial poppet heads 48 feet high constructed over the shaft. A powerful and complete pumping engine and Cornish pump have also been installed and fitted up with all necessary appliances. Steam power is supplied by a 25-horse-power Cornish boiler, with a steam pump and line of pipes to convey the water from the reservoir to the works. Two 6,500 yard tanks have been excavated, and provision made for the storage of upwards of 3,000,000 gallons of rain-water. The main shaft on this mine, 12 feet by 4 feet in the clear, has been carried down to a depth of 170 feet. . . . The chute of ore is from 2 to 17 feet wide, and at the 90-foot level 150 feet long."*

* Ann. Rept. Dept. Mines N. S. Wales for 1902, page 18.

In 1903, the main shaft was sunk to a depth of 288 feet, and drives were put in at the 170-foot and 270-foot levels. In the prospectors' shaft, at the 87-foot level, the load varies from 2 to 15 feet in width, and assayed in bulk at this level from 6 dw. to 1 oz. 6 dw. The average number of men employed was about 28, and the estimated value of the machinery in 1903 was £3,500.

In 1904 the North Lachlan Gold-mining Company—said to be formed of 600,000 2s. 6d. shares—came into possession of the mine. A 10-head battery was completed, and crushing operations were commenced in March. Cyanide works for the treatment of sands and slimes were also erected. Levels were continued at depths of 170, 200, and 270 feet, and along the latter level some irregularly-shaped masses of payable sulphide ore were opened up. The amount of stone raised was 5,036 tons, which yielded 2,062 oz. of gold, valued at £8,330. All costs of mining machinery were said to have been paid for by the end of the year out of the proceeds of the gold won.

In 1905, the amount of stone treated was 5,825 tons, for a yield of 3,786 oz., valued at £14,045. Of this amount, £4,373 had been won by amalgamation, £6,868 by cyaniding of sands, and £2,802 from the cyaniding of slimes. The ore was oxidised at and above the 170-foot level. During this year the estimated value of the machinery was £10,500.

The North Lachlan Gold-mining Company was reconstructed in 1906. No payable ore, however, was opened up that year.

In 1907 a new shaft was being sunk to cut the lode at a depth of 200 feet, and at the point where the Bald Hills alluvial lead crossed it. This was about 2,000 feet north of the main workings. 1,214 oz. of gold, valued at £4,394, were won during the year.

Since 1907 the mine has been idle.

Plans and sections of this portion of the Lachlan reef accompany the report.

iv. Iakwa Proprietary, Limited (Federal Option.)

Owing to the success which attended the prospecting campaign along the southern portion of the Lachlan Lode, a great amount of prospecting was carried on along the line of the lode lying to the north of the North Lachlan Leases. Few, if any, of these attempts were successful. The most determined among them was that which resulted from the efforts of the Iakwa Proprietary Company, Limited (or Federal Option), generally known as The Federal. For information regarding this venture the writer is indebted to Mr. O'Shanassey, one of the prospectors.

The prospecting was apparently undertaken on the advice of the Manager of the North Lachlan Mine, who saw clearly that such a long and powerful line of lode, such as the one under consideration, might reasonably be expected to extend much further to the north than the northern boundary of

the Hauraki lease, and that a payable shoot of ore might reasonably be found therein. The proposal was to sink to 450 feet, and to do a considerable amount of cross-cutting and driving thence.

The main shaft was carried down a depth of 150 feet, and upwards of 2,000 feet of driving and sinking were carried out. The lode was wide, and possessed a good footwall. The assays, however, were poor.

v. *The Britannia.*

The important vein of this name was worked during the very early days of the field. This is shown by the following extract from the *Sydney Morning Herald*, for December 27th, 1861. "About 400 yards to the westward of this shaft and running parallel with the gold struck, a company of miners, under the name of the Britannia Quartz Reef Company, have been granted a prospecting claim. They are at present about 16 feet down, the loose surface quartz is impregnated with gold They are now following a quartz leader dipping to the West estimated to turn out from $1\frac{1}{2}$ to 4 oz. of gold."

The lode, with its country, outcrops as a small, low lying island in the Lachlan River alluvium, an outcrop almost too insignificant in height to be distinguishable at a short distance from the surrounding plain of alluvium. The country is composed of schistose slates and of intrusive andesites. Several leads have been traced up to this lode, namely, the Madman, Grassatt's, and the Britannia, and these all appear to have derived their gold contents from the lode under consideration.

Although the vein appears to bear some intimate relation to the associated intrusive andesites, it must, nevertheless, be borne in mind that the vein material has altered the andesite itself quite as much as the slates or other rocks it traverses. In a letter addressed to the Prospecting Board in 1909, Mr. W. Brooks pointed out how large lenses of pyritic ore had been developed along the course of the lode, so large indeed, that chambers of considerable extent had been excavated therein. This suggests that metasomatism has played an important part in the formation. It may be mentioned in passing that the intrusive andesites accompanying the Britannia lode, are a continuation of the belt which stretches, with breaks, from Forbes to Parkes, and which is everywhere associated with the gold veins.

Very rich stone was obtained from the upper portion of the lode, but after reaching a short depth, the values decreased and mining operations were almost entirely suspended until the year 1885, and the shaft thus fell into disrepair. In 1885, the lode was worked, and Mr. C. S. Wilkinson, the late Government Geologist, reported on it as follows. (Ann. Rept., 1885, p. 128). "The Britannia Reef has been traced for about 2 chains in length, and worked to a depth of 150 feet and abandoned. It is said to have yielded 2 oz. of gold per ton. It occurs in diorite dipping North 31 degrees West. At about 50 degrees, and at the surface it is seen to vary in

width, up to 4 feet, as a network of quartz veins, and is stained with carbonate of copper. The strike of the diorite dyke is about North, 10 degrees East."

Mr. W. H. J. Slee made the accompanying report in 1886.* "The Britannia Reef . . . is situated . . . at the head of the Britannia Lead. rich quartz was obtained out of this reef some twenty years ago by Snow and party, but it was afterwards abandoned and remained so to within eighteen months ago, when another start was made by some of the very men who had abandoned the said reef about twenty years. The company have erected a small ten-stamp battery, which is driven by a 10-horse-power engine. They have crushed several large samples of quartz with payable results. That from the 90-foot, or deepest level, has so far given the best return, namely, 1 oz. 5 dwt. per ton."

The working of the Britannia was again attempted in 1888. A lode about 2 feet in width was exposed, a serviceable crushing and winding plant was erected, and a main shaft was started so as to cut the lode at a depth of 150 feet. By the year 1889 this main shaft had been sunk to a depth of 165 feet. A parcel of 240 tons was treated for a return of 330 oz. of gold. In this year also another vein from 6 inches to 2 feet in width was found about 100 feet east of the Britannia Lode as originally worked.

In February, 1890, Mr. Slee reporting on a site which a portion of the Britannia lode traversed stated that "the site embraces a portion of an igneous dyke which is traversed by irregular quartz reefs, from which the gold in the alluvial deep leads close by have been derived. . . . These reefs are of very uncertain length and thickness, and not till the formation has been proved in depth can it be determined if the several reefs met with are of sufficient extent to justify working."—[P.B. 90/75].

"The Britannia Gold-mining Company struck a reef at the 200-foot level 3 feet wide, heavily charged with pyrites and showing gold freely."—[*Sydney Morning Herald*, March 7, 1890].

"Britannia Co-operative Gold-mining Company Limited, June 29. Main shaft sank 6 feet. The country is hard, dark, blue slate. Winze at 200 feet. level sunk $5\frac{1}{2}$ feet. Water easy. The reef in the winze is rather irregular, about 3 ft. 6 in. wide but the stone . . . prospects about 3 oz. to the ton."—[*Daily Telegraph*, July 4th, 1890.]

By the close of the year 1890 the company had sunk their main shaft a farther depth of 100 feet. Levels were then opened up at the 250-foot level. The lode was found to have been "split up" into smaller portions, but these were found to be not payable. A large stamper-battery was erected about this time but after spending a sum of £12,000 without any return, the company suspended mining operations the while additional funds were being obtained.

* Ann. Rept. Dept. Mines N. S. Wales for 1886, p. 106.

No work of importance was done on the Britannia after 1890 until 1899, when Mr. E. C. Whittell reported on an application for aid by a company which proposed to work the reef again. An extract is here reproduced from his report. The accompanying figures illustrating the occurrence are copied also from Mr. Whittell's report. [Papers P.B. 99-612.]

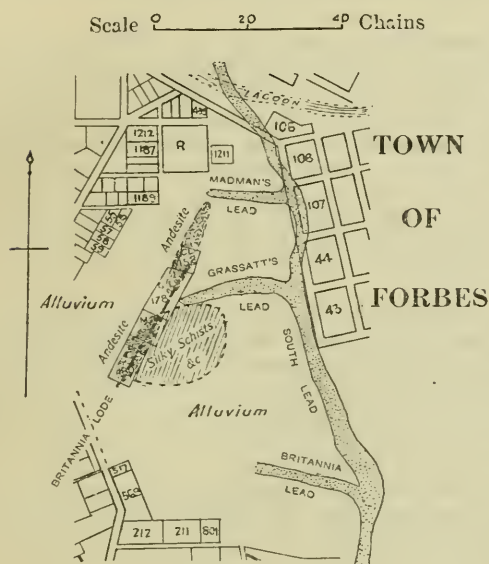


FIG. Sa.

"Diagram No. 1 shows the position of an andesitic dyke, in which occur the gold-bearing veins whose auriferous contents have been shed, forming the three leads named. Many other 'runs,' such as the Union, Caledonian, and Thompson's, have probably had their origin in this belt which appears to run through to Parkes. The Britannia Reef, running parallel to the dyke, and on its western wall, was worked some years ago, and I am informed that good gold was won, but, it is stated, the reef pinched out. About 400 feet north-east from this, applicant and party sunk a shaft in the slate to a depth of 130 feet. Then, expecting to strike a continuation of the Britannia Reef, a

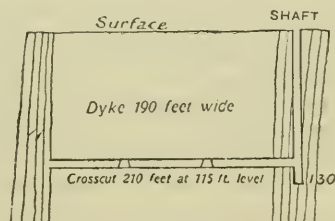
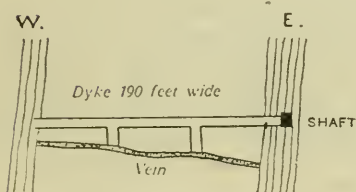


FIG. Sb.

Plan and section (a) Britannia Lead and (b) Lode.

cross-cut was put in at 115 feet, the Board aiding the party. The slate on the western wall was pierced, however, without finding the vein. From this cross-cut two cross-drives were put in, striking a reef about a foot thick. (See Diagram No. 2.) It did not contain payable gold. This undertaking—the driving—proved very expensive and slow work, owing to the water and decomposed andesite, which I am told ran like sand. They claim to have expended £876 over the work. The applicants now desire to abandon their projected southerly drive, as the country is too rotten, and desire instead to sink a new shaft from the surface to a depth of 400 feet, the spot being 400 feet northerly from A."

An application for Government aid to erect a pumping plant to clear out the shaft, and to take out a trial crushing from the 280-foot level, was made by Henry R. Johnson, in 1909. The applicant stated that the lode had not been worked for eighteen years; that a shaft at that time had been sunk to a depth of about 288 feet, but that the lode he proposed to work was a pyritic one, which had been cross-cut from the shaft mentioned at both the 200 and 280-foot levels.

This application was accompanied by a letter from Mr. E. Vanzetti, from which the following extract has been made:—"In the upper regions of the mine the lode paid well, but as time went on further capital was expended in opening up a lower region, which proved to be strongly impregnated with arsenical pyrites. At that time there was no known method of treating this class of ore, the battery alone being entirely ineffective since the foreign matter (arsenic) contained in the ore had the effect of sickening the silver, and rendering it incapable of retaining even the free gold extracted by the mill. In short, the silver and gold would not amalgamate at all, and as a consequence all the gold was lost,

"This property has remained inoperative ever since that time until now, because of the difficulty always experienced in re-floating a mine which has already failed, notwithstanding the fact that such failure was only brought about as the result of ineffective methods of treatment. . . . In draining the Britannia mine one would be practically lifting all the water from the dyke, along the eastern wall, of which it has always been the opinion of geologists that a very rich permanent lode would be discovered at a depth. A good deal of gold-bearing ore should also be discovered along the same line in the upper or oxidised zone of this dyke, for the oxidised zone of the Britannia returned an average of something over an ounce per ton from a reef from 2 ft. 6 in. to 3 feet wide."

vi. Mary's Dream (Strickland's).

According to Mr. Williams, a well-known prospector of Forbes, this line of lode was originally known as Strickland's Reef, and it is stated by some to have been the first lode worked in the Forbes District. Others, again, say that the Britannia was the first lode to be worked. Both, however, were evidently worked very shortly after the great rush had taken place to the Forbes Gold-field. The early prospector of the lode under consideration was Mr. Josiah Strickland, who, early in 1862, saw gold glistening in the quartz of the lode while looking for horses.

The lode is associated with a thick series of silky slates, possessing cleavage developed almost to the point of schistosity. The outcrop is of white cavernous and iron-stained quartz. The vein is large, 3 to 4 feet in width; the strike being almost north and south, and the underlay, which is slight, being to the east.

A shaft has been put down about 150 feet on the underlay. The gold recovered has been confined mainly to the oxidised zone. No parcels of pyritic ore have been sent away.

At various intervals, between the years 1862 and 1886, the lode has been worked more or less successfully. In 1886, Ramsay and party took out a trial crushing from this vein, which averaged 16 dwt. to the ton. In 1902, 80 tons of stone were raised.

vii. The Cripples' Reef.

Associated with the strong Strickland's line of lode are several other well-defined and parallel lodes. On these at various times prospecting for gold has been carried on with varying success. Thus, in February, 1903, seventeen gold leases were applied for along these lodes, particularly along their southern portions. The most successful claim was the Cripples', worked by Morris and party. A shaft was sunk 150 feet on the lode, and at a depth of 85 feet levels were driven 90 feet from the shaft to the north, and 100 feet to the south. The vein at this depth was about 12 inches in width. A shaft was also sunk about 200 feet to the north of the one just described, to a depth of 50 feet on a vein 4 feet in width. A battery was erected about this time to treat the stone, and a return of 240 oz. of gold was obtained from a parcel of 170 tons.

At a later period the main shaft was carried down to a depth of 240 feet.

In this mine water was not encountered at depths less than 200 feet, and the payable gold appeared to have been confined to the oxidised zone. The surface values are given as 10 dwt. to the ton. Below the surface the value of the stone is said to have been 17 dwt. to the ton. The best gold, however, was won between the 80 and 170-foot levels. Below water level a considerable amount of iron pyrites and arsenical pyrites, as also small quantities of galena, were reported. No parcels of pyrites were sent away for treatment, so that the gold contents of the pyrites are unknown.

vi.i. Toss of a Penny.

This lode was discovered by Alexander and party, in 1905, in the vicinity of Cripples' and Strickland's (Mary's Dream) veins. The line of the lode occurs at a little distance to the east of the Mary's Dream line. The country, as also the vein material, of the Toss of a Penny is very similar to that of Mary's Dream. Franks, Williams, and others, work the lode at the present time, and the returns herewith supplied, and taken from the annual reports, apparently refer to the gold yields obtained from this mine.

1906.—*Franks and party*.—140 tons of stone at Daroobalgie crushed for 174 oz. of gold valued at £597.

1907 (p. 14).—*W. and O. Franks* crushed 153 tons of stone from their claim at Daroobalgie for 135 oz. of gold (£473).

1908 (p. 12).—*Williams' Claim*, Parish Dowling, 145 tons crushed for 197 oz. of gold (£727).

A battery was erected at Mary's Dream claim to treat the stone from those lines of lode. The tailings were cyanided at a later date.

ix. The Magpie and Staples' Mines.

The two mines under consideration occur from seven to nine miles north of Forbes, and on the west side of the Parkes-Forbes railway line. Both are treated here under the one heading because of the similarity of their geological occurrence. Both occur in the folded and schistose slates and tuffs of the field, and both appear to belong to the class of ore deposits known as saddle reefs. The mine workings were not accessible during the period devoted to the present geological survey of the Forbes-Parkes Gold-field, nevertheless the evidence of the surface geology points to the saddle-reef nature of the ore bodies. For a description of the latter I am indebted to

Mr. R. M. Alexander, of Tichborne. His clear statement as to the geological occurrence leaves very little doubt as to their "saddle-like" nature. Especially convincing is his description because he has not yet seen the saddle-reefs of other localities, such as those of Bendigo, Hargraves, Turondale, and Condobolin. The ideal section of the Staples' Lode has been reproduced from information supplied by the same gentleman. He describes the Staples' Reef as a narrow ridge or apex, 20 feet in width, which has a pitch and which passes downwards with steeply dipping east and west legs. "A remarkable thing," he says, "is the manner in which the slate of the surface dips against the curved planes of the apex, while the "diorite" [tuffs and arenaceous rocks.—E.C.A.] below the apex has bedding planes which dip conformally with the apex and legs of the reef." Mr. Alexander probably has mistaken the decided cleavage of the surface slates for bedding planes, a very natural error, seeing that the traces of the bedding planes of these finely-grained rocks have been obliterated by metamorphism. The more coarsely-grained strata underlying the lode have not been cleaved because of their greater strength and the traces of their bedding planes have not yet been obliterated.

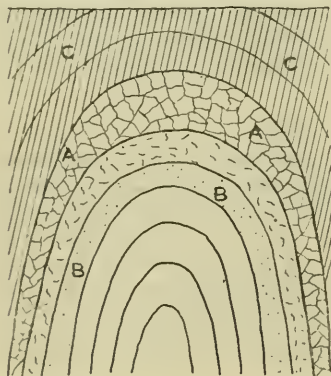


FIG. 9.—Ideal section across Staples' Reef, from information supplied by Mr. Alexander.

- A—Saddle-reefs.
- B—Tuffaceous and arenaceous sediments.
- C—Silky slates showing strong cleavage.

According to Mr. Alexander, the Magpie Reefs are two parallel saddles, that is, the planes of the reefs curve sympathetically one with the other and with the bedding planes of the country. The apex of the Magpie was much wider than that of the Staples', being about 40 feet in width, and moreover "it pitched so gently," says Mr. Alexander, "that the miners could wheel their barrows along its slope." [The pitch was to the South.]

In both the Magpie and the Staples' occurrences the apices alone appear to have produced the payable gold. In the Magpie the apex was followed downwards until a vertical depth of 45 feet below the surface was reached. This clear statement of Mr. Alexander is worthy of being placed on record.

In July, 1884,* Remington and party discovered payable gold at the head

of the Magpie Gully. This lode was called the Eldorado, but it was probably the same as the Magpie. The first crushing of 20 tons gave 3 oz. 6 dwt. to the ton, while a second crushing of 20 tons yielded values of 11 oz. of gold to the ton. The ore body at that time was from 2 ft. to 2 ft. 6 in. in width. A perpendicular shaft was sunk, which cut the reef at a depth of 80 feet. The payable gold was confined to the apex, but the western leg was more productive than the eastern one.

In 1885, a parcel of 220 tons from this lode was crushed for a return of 600 oz. of gold.

In 1889, the main shaft was carried down to a depth of 150 feet, and the vein worked varied in width from 6 inches to 4 feet. Many other claims were taken up on this lode, but they do not appear to have been payable.

Payable gold was also found in the apex of the Staples' Lode, but the legs were poor. About 300 tons of stone were raised for a value of 1½ oz. of gold per ton.

* Ann. Rept. Dept. Mines N. S. Wales for 1884, p. 87.

x. Minor Lodes.

Judd's Lode.—The history of this lode is but little known. It is a large quartz mass, which has a strike similar to that of the micaceous slates with which it is associated.

In 1886, Mr. W. H. J. Slee reported (Ann. Rept. 1886, p. 106) that Judd's Reef occurred about one mile north of Forbes, near the Parkes Road; that it was several feet in thickness, and that a trial crushing had yielded $\frac{1}{2}$ oz. of gold to the ton. The lode has been well prospected above water level.

The Rise and Shine occurs on the North Hill at Forbes. Very rich specimens were reported from it in 1861. In 1889, a shaft was put down 100 feet, and the lode was worked by Patrick Connell and party until the close of the year 1890. Heavy water was encountered by these prospectors.

In 1895, the lode was known as Pennington's. A crushing of 4 tons yielded from 4 to 5 oz. gold. Rich specimens are said to have been found at a depth of 60 feet.

Boyle's Lode.—The lode of this name is distant about two miles north of Forbes, near the head of Thompson's Lead. Formerly it was known as the Trafalgar Mine. After failures on the part of two prospecting parties to prove it payable, it was worked by Boyle, Rymer, and others in 1905. By Boyle's party it was worked for two years, and in 1907 it was again prospected by Messrs. Brain and Rymer. A crushing of 10 tons during this prospecting campaign yielded 141 oz. of gold, valued at £452. During this period the workings on the lode were carried down to a depth of between 70 and 100 feet. The gold shoots worked at this stage of development occurred in patches not more than 18 inches in width and about 4 inches in thickness.

In 1908 Boyle and Rymer obtained encouraging results. Three shoots of gold were worked, and the vein, which had been only 10 inches in width where worked by the previous party, was now found to be from 4 to 5 feet in width. From 11 tons of stone 230 oz. of gold were obtained. The shaft was also carried down to a depth of 120 feet on the underlay. The vein is of quartz and calcite; and the country is andesite intrusive into schistose slates. The strike is north 10° west, and the dip is east at from 45° to 50° . A well-defined hanging wall is present. The gangue, in addition to quartz and calcite, contains both iron pyrites and large bunches of finely-grained arseno-pyrite. The rich gold occurs in short shoots, which are said to dip south at a high angle.

B.—THE PARKES LODS.

i. The Bushman's Lode.

The lode is of quartz having an east-and-west strike and an underlay to the north. The country is of andesite, intrusive into jasperoid claystones and tuffaceous sediments. The lode was rich in the upper levels, yielding returns varying from 3 to 4 oz. to the ton of coarse gold. It appeared, however, to become impoverished at some distance below water level; nevertheless, still later prospecting operations revealed the presence of decided ore enrichments.

Mr. Inspector Hooke informs me that these enrichments are due to the junction of droppers with the main lode, the underlay of both droppers, and lode being in the same direction.

The original Bushman shaft was vertical for a depth of 200 feet, at which point it cut the lode. Thence it was sunk for a depth of 200 feet on the underlay.

After a long period of inactivity, during which the mine was supposed to have been worked out, a party of tributors leased it, and during the first six months of this term they crushed 378 tons of stone for a return of 774 oz. of gold. This was in 1892. In 1893 30 men were employed on tribute, stone being extracted to the value of £5,273 (2 oz. 5 dwt. per ton).

East of the Bushman's shaft a lease had been taken up by Baxter and Saddler during this year, and they sank a main vertical shaft to the north of the lode, with the intention of cutting it at a depth of 500 feet. By December of this year (1893) the shaft had been sunk to a depth of 200 feet.

During the following year 30 men were still working the mine on tribute, and by them 1,558 tons of stone were raised and crushed for 3,972 oz. of gold. The stone was raised from the 400-foot level, where there appeared to be a shoot of gold about 470 feet in length. Baxter and Saddler now cut the Bushman lode and drove to win the rich shoot worked by the tributors who were working farther west.

In April of 1895 the tributors term expired and the mine was worked by the company. Machinery also consisting of a 20-stamper battery was erected for treating the ore. One crushing of 800 tons yielded 1,327 oz. of gold. 1,800 feet of levels were opened up this year. The area immediately west of the "Bushman's" was taken by the Bushman's Freehold Syndicate and prospected. About this time also both the old Bushman and the Baxter and Saddler's properties were amalgamated and renamed "The New Bushman's Hill."

In 1896 the main shaft was 430 feet deep and the erection of a cyanide plant was contemplated; 5,124 tons of quartz were raised which returned 5,000 oz. of gold, valued at £17,500.

During the year 1897 the shaft was carried down to a depth of 700 feet and drives were put in for a length of 1,085 feet, about 85 men being employed; 3,023 tons of quartz were crushed for a yield of 2,064 oz. gold, and 4,684 tons of tailings were treated for a yield of 562 oz. gold. A cyanide plant was also erected this year and the mine was equipped with three patent safety cages.

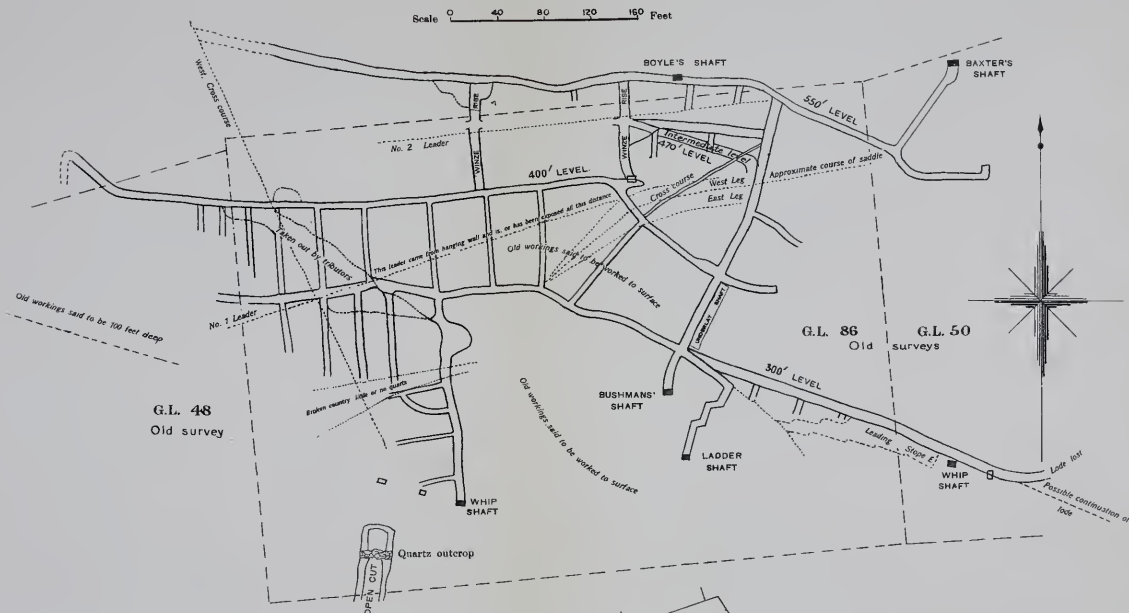
In 1898 mining operations were suspended for three months by the New Bushman's Gold-mining Company. The main shaft by this time had been sunk to a depth of 847 feet. Government aid was applied for and granted to enable the company to prove their mine at still lower levels.

The following notes, with the accompanying figures, have been extracted from Mr. Inspector Hooke's report on the mine during this year. [Papers P.B. 98-4216]:—"The workings effected consist of several shafts etc., the main perpendicular shaft being 700 feet deep at which point the vein was intersected and a level driven east and west. At a point 444 feet west from the shaft, a winze (No. 2) was sunk from this level to 846 feet and at 800 feet a level was opened and has been extended to distances of 80 feet and 126 feet east and west respectively.

The bottom of No. 2 winze is the deepest working effected in the mine, and although applicants state they propose "to further sink the main underlay shaft" they really refer to the winze mentioned herein.

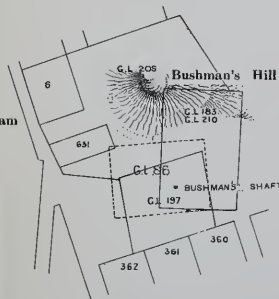
PLAN OF WORKINGS OF THE NEW BUSHMAN'S HILL GOLD MINE PARKES

Taken from Mine Manager's Plan



LOCALITY PLAN Parish of Currajong County of Ashburnham

Scale 0 4 8 Chains



Under these circumstances it must be noted that everything hauled from the winze must be trucked along the 700-foot level and again hoisted to reach the surface. . . .

. . . The vein . . . exhibits all the features of a true fissure vein, and in its downward course has been subject to but little replacement, hence its further extension to a great depth may be reasonably assumed.

Its underlie is remarkably free from variation The vein inclines at an angle of 40° from the vertical and towards the north.

Laterally, the vein has been opened up for a length of about 1,000 feet; in this direction faulting has been frequent and considerable, and during the early history of the mine the peculiarities of these heaves were baffling; now however, as a result of much prospecting, no difficulty is experienced.

The position of the vein has been more or less determined beyond the boundaries of this company's claim, hence in length as well as depth the extent of fissure seems sufficient to justify expenditure on deeper exploration.

The concentration of the work in the vicinity of the winze is owing to the need of hugging a "volcanic" dyke in proximity to which the best stone has been obtained.

The gold-bearing portion of the vein contents is confined to the quartz which has been compact and continuous from the outcrop to present depth and at no time less than a foot in thickness, sometimes swelling to twice that amount.

From the surface downwards the yields were stated to vary from 5 to 3 oz., this continued to a depth of about 400 feet when a sudden drop in value occurred, after which a yield of 1 oz. was the maximum."

Mr. Hooke recommended that Government aid be granted to sink the No. 2 winze (known also as the main underlay shaft) to a depth of 1,100 feet from the surface, the average aid to be 45s. per foot from the 846-foot to the 1,100-foot level, being half the estimated cost of sinking in this hard country.

In 1899 the winze was sunk to a depth of 925 feet; the 800-foot level was extended 155 feet, and 968 tons of ore were treated for a yield of 541 oz. of gold. While sinking from the 846-foot level to the 925-foot level the prospects were discouraging, and the gold shoot was believed to have left the winze well to the east. The Prospecting Board was asked to transfer the aid from sinking below a depth of 925 feet to driving at the 800-foot level. The application was refused.

In the year following (1900), 420 tons of stone taken from the Bushman yielded 339 oz. gold. The machinery attached to the mine at this date was valued at £2,000.

In 1901 very little work was done, and 77 tons of stone only were treated for a return of 69 oz. gold.

In the following year the treatment of 365 tons of quartz yielded 219 oz. gold.

Since the year 1902 very little work has been done on this important line of lode. It must be remembered, however, with this as with the Buchanan and Phoenix lines, that in the early days of the field the miners abandoned it as being hopelessly worked out. With deeper sinking and extended mining operations, however, fresh and payable ore bodies were located. Nor can it yet be said from our knowledge of the Bushman Mine as revealed in the imperfect records here presented that it has yet been completely prospected.

An incomplete plan of the Bushman is here reproduced.

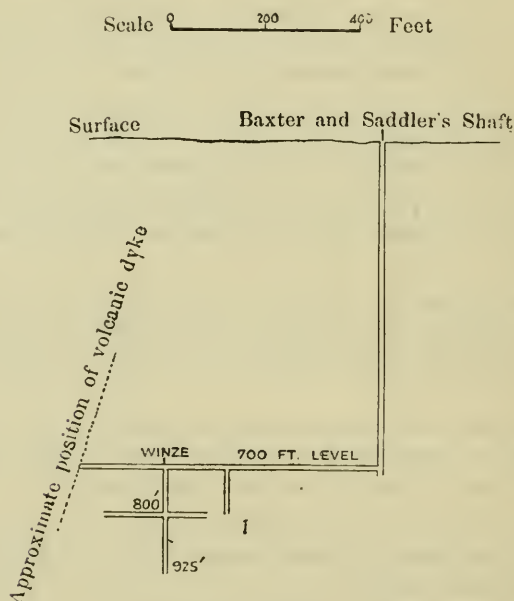


FIG. 10—Adapted from Mr. Hooke's report, illustrating method of working lower levels in the Bushman Mine.

ii. The Buchanan and Phoenix Lines.

The official information regarding the early working of these lines of lode is very meagre. The Buchanan appears to have been prospected during the early days of the field, but abandoned temporarily, and then re-opened by Messrs. Coleman, Paravicini and party, while they were working the Great Northern Lead in 1876. The country of the lode is andesite, which is intrusive into slates. Although the vein material appears dependent in some manner upon the associated andesites, nevertheless the latter have been much altered by the action of the solutions from which the vein contents have been deposited. The vein itself has a north and south strike, whereas the neighbouring lode of the Bushman has a course almost east and west. The line of lode, although of considerable length, nevertheless possesses no outcrop, being covered by a thick cap of alluvium.

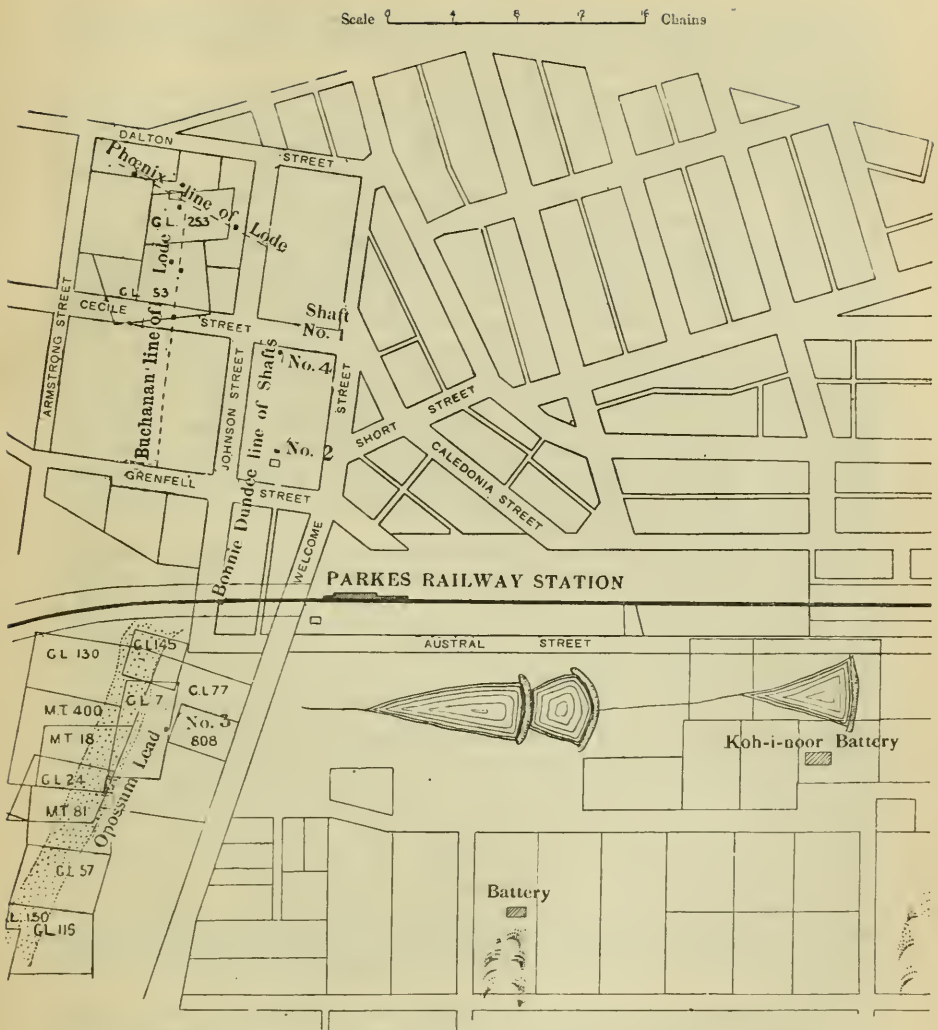


FIG. 11.

The Phoenix, on the other hand, is the same lode as the Quayle's, and cuts the Buchanan,* throwing it for a considerable distance (30 feet.)

The higher levels of the Buchanan yielded handsome returns; but between the dates 1867 and 1882 the lode was supposed to have been worked out. The Department of Mines was approached with a view to having the mining reserve cancelled in this locality, so that it might be disposed of in small allotments. That Department considered the time inopportune for alienating this land, and retained it within the mining reserve.

About the year 1882 a revival in prospecting operations took place, and the Buchanan Lode was exploited. Excellent results were obtained, especially from one claim known as "The German's."

* Information supplied by Mr. W. Leighton.

The greatest interest, however, centres round the history of Haselhurst's (Phoenix) and Quayle's Mines, which belong to the Buchanan system, and which about this time were being opened up.

Haselhurst's Mine is situated mainly on a vein which faults the long main Buchanan line of lode. The facts leading up to its working are much as follows:—Towards the close of 1883, Mr. Wm. Haselhurst took up an extended claim (200 feet x 400 feet) on the Buchanan Lode. A shaft was put down by him through the alluvium, which was bottomed at 80 feet on andesite. The stone there was not payable, and an old shaft on the line of reef was then examined by him, and a drive put in along the lode for 38 feet. This attempt also proved unsuccessful. By a careful examination, however, of the "spoil heap" belonging to this old shaft, Haselhurst was led to suspect the existence of a payable vein of quartz in the shaft itself. An old drive was found going in from the shaft, and in it a leader 6 inches in width was found. Although this appeared to be "pinching" out at this point, nevertheless, he obtained good prospects, 13 tons of stone being raised and crushed for 3 oz. of gold per ton. Haselhurst then sank a shaft at the end of his mine, and found a shoot of gold 120 feet in length. From that time onwards for years the mine became payable. Between the dates, December, 1883, and December, 1887, 6,538 oz. of gold were obtained by Haselhurst, for a treatment of 1,383 tons of stone.

In 1884, Haselhurst crushed 120 tons of stone for 800 oz. gold. Quayle and party about this time, also, took up an adjoining claim on this cross lode and raised 480 of stone, of which 237 tons yielded 700 oz. of gold. Still a third payable claim was taken up on this cross reef. In 1885 both Haselhurst's and Quayle's claims were paying well, the former winning 1,667 oz., and the latter 1,260 oz. of gold.

In the year 1885, Mr. Slec, late Chief Inspector of Mines, reported on the Buchanan line.* After mentioning the failure of the David Buchanan Gold-mining Company, through insufficient prospecting, he shows how Haselhurst found the leader, and briefly describes the character of the reef. At that time (1885), J. Quayle and party were working a vein about 100 feet from the surface, the deepest part obtained being 200 feet; and at the latter depth the vein averaged about 2 feet in width. Up till that time 914 tons of quartz from this mine had yielded 4,203 oz. retorted gold.

In Haselhurst's claim the quartz lode averaged 2 feet in thickness, the country being of soft andesite, which required no blasting; 656 tons of stone had been raised, which yielded 2,136 oz. of retorted gold, valued at £3 19s. an ounce.

Mr. C. S. Wilkinson, reporting on Haselhurst's Lode during the same year (Ann. Report, 1885, p. 128), said:—"The shaft is 105 feet deep, and the reef dips North 15° to 35° East, at from 40° to 60°. The crushing stuff up to 3 feet thick is ferruginous, with quartz occurring in shoots, one shoot being 30 feet long and 2 feet thick, thinning to each end, and dipping north-westerly at about 50°. The hanging wall shows several inches thickness of white clay, slickensided against feldspathic rock, and the footwall is the same, with, in one place, coarse pebble conglomerate. The yield of 106 tons crushed in April gave 522 oz. of gold.

In this year Haselhurst crushed 390 tons of stone, and Quayle and party 750 tons, both averaging 4 oz. of gold to the ton.

During 1886, Quayle and party from their claim obtained 1,512 oz. of gold from 504 tons of quartz, and Haselhurst obtained 1,755 oz. of gold from 351 tons of stone.

* Ann. Rept. Dept. Mines N. S. Wales for 1885, p. 100.

In 1887, Haselhurst crushed 450 tons of quartz for a return of 2,745 oz. of gold.

In 1888, Haselhurst's and Drummond's were the two claims working the Phœnix Line. The former claim yielded 740 oz. and the latter 860½ oz. of gold. Quayle's claim had apparently been taken in this year by Drummond and party.

The next year, the Mining Registrar reported the greatest depth in Haselhurst's claim as 220 feet, and in Drummond's claim as 237 feet. The respective widths of the lodes were 18 and 24 inches. From the former, 483 tons of quartz yielded 2,756 oz. of gold, while from the latter claim 167 tons yielded 337 oz.

In 1890 Haselhurst sold his claim for £20,000, the new name being the "Haselhurst Proprietary Company." At this time, the main shaft was 310 feet deep, and the vein at the bottom was 5 feet wide, whereas, at 200 feet depth, it was only 8 inches wide in a shoot of stone south-east from the shaft. A 20-head stamp battery was erected, and connected with it were four Alley percussion tables, and two Arastras. Customs work was also undertaken by the company. The first crushing after the sale yielded 844 oz. of gold from 200 tons of stone. By the close of 1891 the company had their main shaft down to a depth of 360 feet, and the lode varied from 1 foot to 4 feet in width.

Since commencing operations the company had treated 1,489 tons of stone for a yield of 1,807 oz. of gold. [At this period both the Haselhurst's and the Koh-i-noor Mines were under the same management, and 110 men were employed in the two mines.]

In 1892 the only record of this line of lode is the fact that Quayle's Proprietary Company's shaft had been sunk to a depth of 395 feet.

In 1893 both Haselhurst's and Quayle's old claims were worked on tribute, but unsuccessfully.

In 1894 and 1895 the old Haselhurst's and Quayle's claims were again under tribute.

The following year Haselhurst's claim was re-named the Phœnix. During this year, the values of the stone raised were 1½ oz. of gold per ton, but the vein worked was small.

A tribute party during 1897 worked a cross-leader at the 400-foot level of the Phœnix claim. The stone yielded over 2 oz. of gold per ton, but the country was very hard. At Quayle's the same leader was being worked as in the Phœnix, where it was small but rich.

During the year 1898, the Phœnix crushed 330 tons for 370 oz. of gold, and the Quayle's Gold-mining Company crushed 64 tons for a yield of 172 oz. of gold. Work in the Phœnix at this time was confined mainly in the vicinity of the 400-foot level.

In 1899 the tributors crushed 520 tons of stone for a yield of 903 oz. of gold.

The following year twenty tributors were employed in the Phœnix claim, and 1,050 tons of stone were treated for a yield of 1,922 oz. of gold. The machinery on the lease during this period was valued at £450, and already from this claim, over £60,000 worth of gold was said to have been taken.

Immediately adjoining the Phoenix, to the east, another claim was taken up about this time on the same lode as the Phoenix. A vertical shaft was sunk 320 feet, with the intention of cutting the vein at 500 feet, and the new claim was called the East Phoenix.

In 1901 the Phoenix was taken over from the tributors and a crushing of 760 tons of stone was made, which yielded 647 oz. of gold. At the same time the Phoenix Gold-mining Company was issued in 10,000 shares at 10s. each.

In the East Phoenix the vertical shaft was carried down to 500 feet, and cross-cuts put in at various depths. Nothing valuable was found, however, during this year, the highest return being $\frac{1}{2}$ oz. a ton from 36 tons of stone.

The following year a level was put in at 400 feet from the East Phoenix shaft, so as to connect the two Phoenix mines, the shaft of the original Phoenix having fallen into disrepair. The distance between the shafts at this level was 106 feet. From the 400-foot level in the original Phoenix, a winze was sunk 40 feet in the year 1903. At 500 feet a level was driven from the East Phoenix shaft to connect with a winze in the Phoenix. This drive was 170 feet long. The vein in the winze varied from 20 inches to 36 inches in width, and was valued at 18 dwt. of gold per ton. During the year 626 tons of stone were crushed for 581 oz. of gold.

Very little work was done at the Phoenix during 1904. The upper levels were let to tributors, but they soon abandoned the mine. 271 tons of stone were crushed for 205 oz. of gold during this year.

In July, 1904, Mr. William Tanner declared that the Phoenix Gold-mining Company (No Liability) had purchased the mine at a cost of £22,000 (P.B. 04-2566). No dividends had been received by the shareholders, and about £7,500 had been spent in mining operations in addition to the proceeds of gold won from the mine. In 1905 gold to the amount of 258 oz. was won from 300 tons of stone. The Phoenix East Gold-mining Company was amalgamated with the Phoenix about this time, the better to test the current opinion that rich shoots of ore would be found in the lower levels of the Phoenix, in much the same way as they had been found in the Bushman Mine. Lack of capital, however, prevented any determined effort being made to prospect the lower portions of the lode. In 1906 a distance of 200 feet was driven at the 500-foot level in the Phoenix Reform Gold-mining Company's Mine (as it was called in 1905), and a considerable amount of stoping was done between that and the 400-foot level; 404 tons were crushed for a return of 418 oz. of gold during the year.

Mr. G. Smith, Inspector of Mines, reported on this lode in October, 1906. At the time of his inspection, there were three veins in the mine. Of these the main vein possessed a strike in a north-west and south-east direction, and an underlay to the south-east. Stopping was carried out along the lode in June, from the 400-foot level where the vein was 2 feet wide. It was also stoped at the 550-foot level, where it was found to be split into two portions, about 16 and 18 inches in width respectively. No. 2 was a north and south vein, and stoping was conducted on it also.

No. 3 was a branch vein having a strike east and west and an underlay to the north. This branch vein was driven on at the 500-foot level. At that depth it was 6 inches wide, and valued at 2 ozs. of gold a ton.

In 1907 another unsuccessful prospecting campaign was carried out; 186 tons of stone were crushed for a yield of 107 oz. of gold. The machinery at this time was valued at £1,607.

Taken from Mine Manager's Plan

PLAN OF LEVELS.



Scale 0 1 2 3 4 Chains

[illegible]

The diagram illustrates a vertical shaft system with two parallel shafts. The left shaft is labeled 'LADDER SHAFT' and the right shaft is labeled 'MAIN SHAFT'. A series of steps are shown, numbered 1 through 9. Steps 1, 2, and 3 are on the LADDER SHAFT. Steps 4, 5, and 6 are on the MAIN SHAFT. Steps 7, 8, and 9 are on the LADDER SHAFT. The steps are connected by horizontal rungs, forming a zig-zag pattern between the two shafts.

In 1908 and 1909 a considerable amount of prospecting was carried out on a cross vein at the 400-foot level in the Phoenix Claim. The vein was large and well-defined, but up to the present the gold yields have been disappointing.

iii. The Koh-i-noor Lode.

The early history of the Koh-i-noor workings is not well known, although it is officially reported that Aaron Johnson and party discovered it about the year 1879. The vein is about 3 feet wide and was found under alluvium near the Forbes road and about one and a half miles south of Parkes. Its strike is almost east and west and its dip is to the south.

In 1887 a considerable amount of prospecting was carried out along this vein, excellent gold returns being obtained.

During the year 1889, 426 tons of stone were treated for a return of 670 oz. of gold. At this period the depth of the workings was 60 feet and the width of the lode 18 inches. The mine was sold for £8,000, and its name was changed from that of the "Old Caledonian Reef" to that of the "Koh-i-noor."

Steady progress was made in 1891, the lode being worked to a depth of 160 feet; at this depth the width of the lode was 3 feet. The company was registered in July, 1891 [22 shares each of £400] and since commencing operations 1,624 oz. of gold had been won, valued at £5,447.

From 1891 to 1898 mining operations were of an unimportant nature only.

In 1895 and 1896 the mine was worked on tribute and the men obtained good returns. By the close of 1898 further prospecting had taken place. The shaft had been sunk to a total depth of 455 feet and in doing so a payable lode had been cut from which excellent returns had been obtained. A vein subsidiary to the main Koh-i-noor was found at this level, and at their junction rich gold was obtained. During the year 2,019 tons of stone were crushed for a return of 790 oz. of gold.

The main shaft was carried down to a depth of 550 feet in 1899. At that depth a level was driven 167 feet east and 151 feet west. A cyanide plant was added to the company's outfit, and during the year 3,795 tons of stone were treated for a return of 2,271 oz. of gold, worth £8,313; 45 men were employed this year on the mine.

By the close of 1900 the main shaft had been sunk to a depth of 650 feet. The lode so exposed was 3 feet in width. The company by this time possessed a battery of twenty stampers, with a concentrating and cyanide plant, and 5,000 tons of quartz were crushed for a return of £12,000. £5,346 are reported to have been paid this year in dividends.

During the following year the main shaft was carried down from the 650-foot to the 800-foot level. The Mining Registrar reported that from the 450-

foot to the 650-foot level the mine had yielded 9 dwt. a ton, while from the 650-foot to the 750-foot level the reef had not been payable. The lode in various parts of the mine had varied from 6 inches to 10 feet in width. Mr. Inspector Hooke, in reporting upon the mine in 1901, said that a parallel quartz vein, as much as 18 inches in width was being worked on the lease, and a crushing of 39 tons had yielded 25 dwt. of gold to the ton over the plates; that 35 men were employed about the mine; and that the latter was in the hands of a company of 21,000 £1 shares. In this year also 2,605 tons of stone were crushed for 923 oz. of gold. The machinery belonging to the company was valued at £4,500.

On the 10th February, 1902, the Koh-i-noor Gold-mining Company (No Liability) made an application for aid from the Prospecting Vote to further prospect the Koh-i-noor. The following is an extract from that report. [P.B. 02-549] The mine has been worked for the past ten years with varying results. Dividends were obtained between the surface and 300 feet, from that depth to 450 feet was blank, after which dividends were again obtained between 450 feet and 650 feet, from the latter level to about 800 feet (the present depth of the mine) the stone carried gold but not sufficient to pay working expenses; but appearances in the bottom point to another make of profitable stone which may be proved by sinking to a depth of 850 feet, and then opening out. During the time the mine has been worked the company has spent £18,420 in wages, and £1,992 in contract work at the mine, in addition to the labour of a number of men who worked the mine on tribute for three years, besides which large sums were expended in explosives, mine stores, machinery, and crushing.” Aid was granted to sink the shaft a further 100 feet and to drive thence 100 feet along the lode. Before the close of 1902 the shaft was sunk from the 800-foot to the 900-foot level, and a drive put in thence 100 feet to the east, while, during 1903, levels were driven east and west from the bottom of the shaft; 217 tons of stone were crushed for 210 ounces of gold the same year.

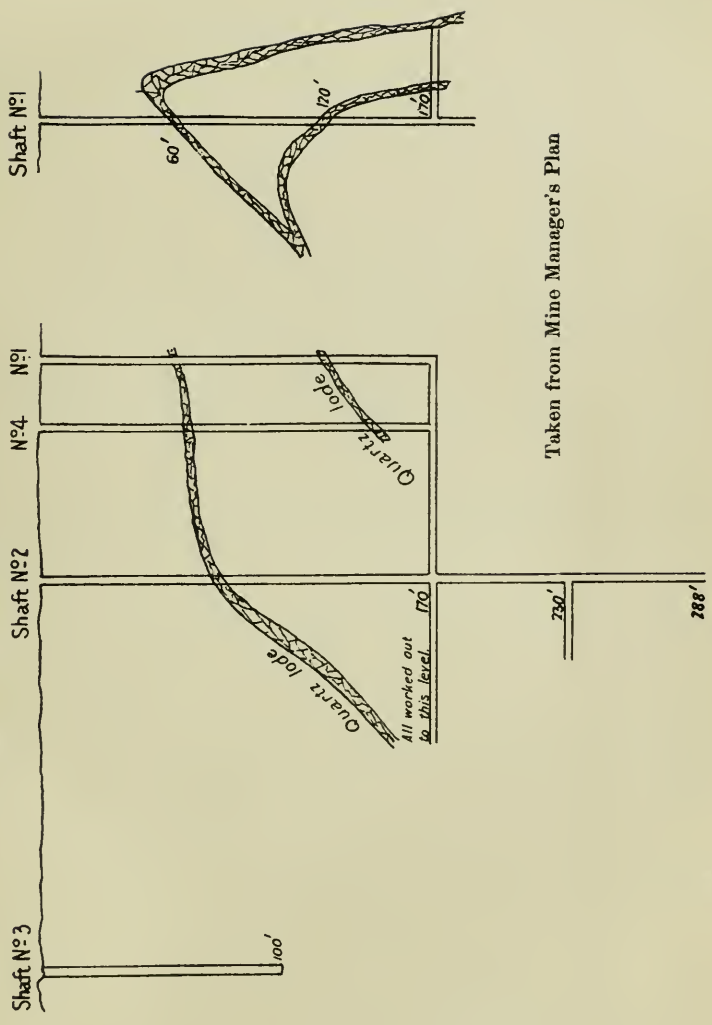
During the following year the shaft was carried down a further 50 feet. Prospecting was also carried on along both veins between the 350-foot and 400-foot levels.

At a later date the main shaft was carried down to a depth of 998 feet, but no important work appears to have been done on this reef since 1904. In 1906 a small crushing yielded 69 oz. of gold, and 6,000 tons of tailings were treated for a return of 504 oz. of gold; while in 1907 again a small parcel of 46 tons was treated for a return of 41 oz. of gold.

Through the courtesy of Mr. W. Tanner, of Orange, a tracing of the plans of the Koh-i-noor workings is here reproduced. From the descriptions of Mr. Tanner and Mr. Mining Inspector Hooke, it is evident that the payable gold occurred in this reef in zones more or less horizontally disposed. A similar phenomenon is reported from the Bushman Lode by Mr. Inspector Hooke.

Longitudinal Section

Cross Section



Taken from Mine Manager's Plan

iv. The Bonnie Dundee Gold-mine.

This mine is situated in the township of Parkes. Immediately to the north of the Bonnie Dundee Leases lies the Phoenix Lode, while the main Bushman Line lies a few hundred yards to the westward,

Mr. Thomas Mitchell was one of the prospectors of the Bonnie Dundee, and he discovered the payable lode in April, 1876, at a depth of 80 feet under the alluvium by making use of an alluvial shaft in an old block claim on the Bushman's Lead. By the end of the year, 1876, the deepest shaft was 90 feet, and the lowest level was 104 feet below the surface. The width of the vein varied from 4 inches to 3 feet, and the underlay was scarcely perceptible. About 31 men were employed during the year. One small parcel of 8 tons yielded $4\frac{1}{2}$ oz. of gold to the ton; one of 70 tons, and another of 982 tons yielded from 6 dwt. to 10 dwt. to the ton.

Along the southern portion of the Bonnie Dundee, Ehlers and party obtained good returns. The lode was struck at a depth of 105 feet; its width was from 6 inches to 3 feet, and it underlaid about 45° [Ann. Rept. Dept. Mines, N.S. Wales, for 1876, p. 90.] 38 tons of stone were crushed for 19 oz. of gold, and 77 tons for 22 oz. of gold.

In 1877 the lode was worked, but with only slight success.

In 1878, 444 tons of stone were treated for 450 oz. of gold, valued at £1,575.

In 1879 good returns were obtained by Medlyn and party, and in 1881 these prospectors crushed two parcels of stone from the Bonnie Dundee, one of 624 tons for $13\frac{1}{2}$ dwt. of gold per ton, and one of 250 tons for a yield of 200 oz. of gold.

By March, 1882, the same party (Medlyn's) had followed the vein down to 170 feet depth on the underlay, and had driven horizontally on it for 400 feet. The vein here was 2 ft. 6 in. wide. Below the 170-foot level three winzes had been sunk on it.

"The Bonnie Dundee Reef, which was abandoned two and a half years since, has been taken up by Medlyn and party, who have crushed from it 2,773 tons of stone for 1,501 oz. 11 dwt. of gold; the vein averages about 18 inches in width; another party on the same line of reef have crushed 352 tons for 431 oz. of gold." [Annual Report, 1883, p. 13].

At a later date this property of Medlyn and party was formed into the Bonnie Dundee Gold-mining Company (Limited).

In 1885 two parcels of stone were crushed from this lode, one of 118 tons for 1 oz. of gold per ton, and 110 tons for 8 dwt. per ton.

"It is impossible for me to give you a return of the gold won from these properties, as the upper ground was worked for many years before I had anything to do with the management (of the Bonnie Dundee.—E.C.A.); but I have myself taken out 1,526 oz. from the eastern leg of the reef, and 220 oz. from the western leg near the shaft, (marked "3"), and 654 oz. from near the shafts marked "1" and "2." All stone crushed under my management would average about 14 dwt. per load."—[Extract from letter by J. Medlyn.]

The accompanying plans and sections show the amount of work done in Medlyn's claim:—

v. The Dayspring Lode.

The Dayspring was among the first of the veins discovered in the Parkes District. James Pugh had found payable gold at the Pioneer Reef in October, 1862, and the Dayspring, in its immediate vicinity was found shortly afterwards (see plan of Dayspring and Pioneer Lodes, Fig. 12.)

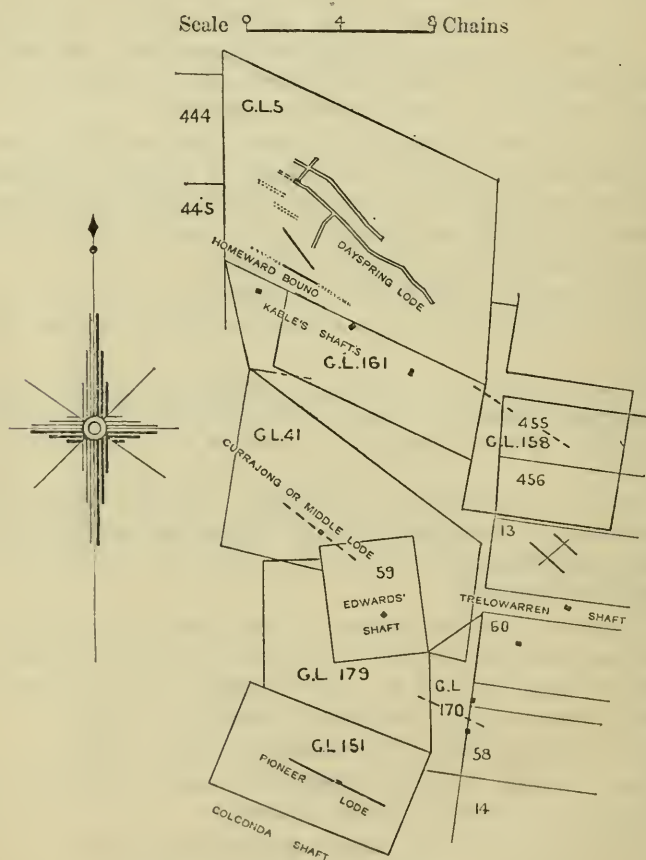


FIG. 12.—Plan of the Dayspring, Homeward Bound, and Pioneer Lodes.

The lode has been worked intermittently from 1862 to the present time. By the end of 1866 all the Parkes lodes—the Dayspring included—were thought to be worked out, but at least on two subsequent occasions the Dayspring has been worked with success. The underground workings not being accessible during the geological survey of Parkes, the description of the mine has been obtained from official and other reliable records.

The strike of the lode is almost east and west, and its dip is to the north. The quartz of the lode is characteristically opaque and solid, with iron and arsenical pyrites. Fahlore is also in places associated with the gold.

It has already been pointed out that the Dayspring had been worked profitably between the years 1862 and 1866, and then abandoned temporarily. In 1872, however, the lodes of Parkes were again tried, and miners entertained great hopes of their values. Among others the Dayspring was worked, under the management of Mr. Phillip Davies, who continued to obtain payable stone till the end of the year 1875.

In 1875 Mr. Warden Dalton* reported on the mine as follows:—"The working of this mine (The Dayspring Gold-mining Company), poor as it may be, is productive of enormous advantage to this district, where reefs abound in every direction, that, if efficiently worked, will yield from 5 to 10 dwt. of gold per ton. . . . The Dayspring Company has crushed, between the 1st of January and the 31st of December, 1874, 5,674 tons 13 cwt. of quartz; raised from a mine 250 feet in depth, and taken from a lode 2 ft. 6 in. in thickness, invested by hard blue rock, . . . this stone produced 3,158 oz. 3 dwt. of gold, worth only £3 7s. 6d. per oz. . . . The entire cost of raising and crushing the stone and extracting the gold is £1 11s. 2d. per ton. . . ."

In 1875 work was again discontinued, and the mine was practically abandoned until the year 1885, when 100 tons were taken from the lode for a yield of 12 dwt. gold to the ton.

In 1893 a party of tributors crushed 137 tons of gold for a return of 204½ oz. g.-ld. Returns from this mine had usually averaged about 6 dwt. per ton, but at the 200-foot level the much richer stone just mentioned was found.

The mine was worked also on tribute successfully during 1894.

In 1895 the mine was worked by a syndicate, who proved the vein to a total depth of 375 feet, and drove along its course at the 200-foot level for a distance of 500 feet.

In 1879 the Mining Registrar† stated that:—"The Dayspring mine embraces 30 acres of land. During the last year this company has driven 300 feet at the 200-foot level, and 250 feet at the 300-foot level; also 150 feet at the 400-foot level. They have crushed 2,500 tons of stone for an average yield of 6 dwt. per ton. . . ."

One dividend of £500 has been paid during the past year.

Again, in 1908, a crushing of 853 tons yielded 234 oz. gold.

At the close of 1899 the mine had been worked more or less continuously and successfully for sixteen years. During ten months of this year 1,052 tons were crushed for a return of 402 oz gold. The proceeds did not pay the tributors more than £1 per week wages.

During the following year the Dayspring changed hands, and was renamed the "New Dayspring." This was a no-liability company with a capital of £8,000, comprised of 16,000 shares at 10s. each, all contributing. A new shaft 12 ft. by 4 ft. was sunk to a depth of 130 feet on a vein 3 feet wide.

In 1901 the new shaft was sunk to a depth of 317 feet on the underlay, with a double tramway for the cages to the bottom. Another tramway overhead conveyed the ore to the 20-head stamper-battery, which had been

* Mines and Mineral Statistics for 1875, p. 40.

† Ann. Rept. Dept. Mines N. S. Wales for 1897, p. 33.

erected during this year. Two tanks were made, one of 1,000 yards, and the other of 1,500 yards capacity. The machinery was driven by a 40-horse-power boiler, and included two Wilfrey concentrators and a stone-crusher. Eight hundred tons of stone were treated this year for a yield of 6 dwt. of gold per ton.

In 1902 a parcel of 522 tons were treated for 196 oz. gold, and in the following year 757 tons were treated for 198 oz. gold. A rise also was put up for about 150 feet from the 288-foot level on a vein from 1 to 4 feet in thickness.

During the year 1904 470 tons of stone were treated for 186 oz. of gold. Later in the year mining operations were suspended and the machinery sold.

In the following year mining operations were confined principally to prospecting work.

In 1907 the mine was unwatered, and preparations were made for stoping at the 300-foot level.

In 1908 the gold returns were unsatisfactory, and the prospecting work also was disappointing. About 703 tons of stone were treated for a yield of 219 oz. only of gold, valued at £724.

vi. London Line.

This includes the Victoria, London, New Haven, Band of Hope, and some minor quartz lodes. The conditions determining the ore entries here differ considerably from these which gave rise to the Buchanan and other lodes associated with the long north and south line of andesitic intrusions to the east. In the one case the gold values appear to have followed the lines of contraction in the andesite and the associated sediments. In the other they appear to have been deposited along lines of powerful shearing and crushing, without the accompaniment of intrusive rocks.

The belt of country containing the London group originally consisted of both sandy and calcareous clays. During mountain-making movements these were changed, first to slates, and finally in part to chloritic slates, calcareous and micaceous schists. Along the line of crushing lenses of quartz were developed, as shown typically in Fig. 5, which was taken from the end of the open cut of the London Mine itself. In one place these peculiar eyes of quartz were parallel to, and continuous with, each other across a whole section of the mine 33 feet wide. All along the line this peculiar feature is repeated in greater or less perfection. The spaces between the quartz eyes are occupied by crushed and chloritic slate material. In general, cleavage and schist planes are observed to curve sympathetically with the reef or large quartz eyes. (See Fig. 5.)

It thus appears that the London ore body was produced by solutions which worked along zones of crushing, and that the ore body was developed during the crushing stage. Thus while the shearing and crushing operations were in progress the heated solutions of silica followed the lines of least resistance, and under conditions of great load gradually replaced the country (crushed slate) along these lines of least resistance. In this way an "augen" or eye-structure was formed by the quartz.

London Mine.—According to Mr. S. C. Woodward, the proprietor, the London was first worked about thirty-three years ago.

In 1904 the property came into Mr. Woodward's hands, and since that date he has extracted about £13,782 worth of gold.

In 1905 the lode was developed by means of an open cut and it was then ascertained to consist of an extensive low-grade formation. (See accompanying plan.)

A large lens of ore 100 feet deep and more than 50 feet in width in its central portion has been worked. It is an enlargement of a vein of quartz which doubtless will make into similar large chambers or lenses of ore at other points.

After carrying the open cut down to a depth of 100 feet a level was run beneath it. The lowest workings are 144 feet below the surface, and the stope at the bottom is 7 feet wide. An inclined tramway conveys the ore from the bottom of the open cut to a brace 50 feet high, the latter being about two chains distant to the north from the old shaft which is alongside the open cut. At first the stone was treated in lumps and passed direct from the mine to the cyanide plant. At a later date it was dropped from the brace into a rotatory rock-breaker; thence through Crom rolls, placed vertically below this in turn, until a gauge of three-eighths of an inch was obtained. Thence the stone falls into large hoppers and so passes direct into four 40-ton cyanide vats. One 100-ton vat is also in use. As a result of this reduction of the stone to a much smaller gauge the extraction rose to nearly 75 per cent. of the assay value of the stone.

The average value of the stone is 3 dwt., and the average extraction is about 2 dwt. of gold a ton.

The machinery erected by Mr. Woodward, in 1905, was valued at £2,000. From April, 1905, till December of the same year 4,140 tons of stone were treated for a yield of 529 oz., valued at £1,682.

In 1906, 5,880 tons of stone were treated for bullion valued at £2,651.

During the following year 5,320 tons were cyanided for 779 oz. valued at £3,021, while in 1908 the cyaniding of 7,310 tons yielded gold to the value of £2,801.

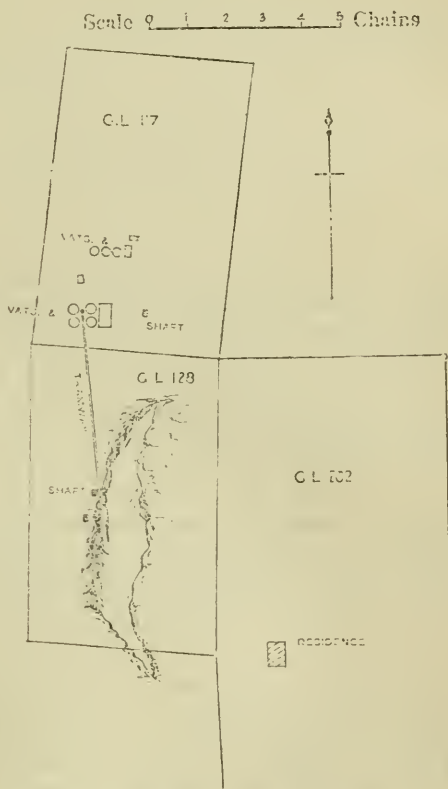


FIG. 13.—Sketch plan of London open cut.

In all about £13,782 worth of gold have been won from this mine up to date.

Work has been suspended here during the latter part of 1909.

The Victoria.—This property is situated a little distance to the south of the London and along the same line. It consists of a number of quartz veins traversing crushed slate country. In June, 1876, Wright and party registered a claim over the Victoria veins. A large formation was prospected, from which a crushing of 70 tons yielded 12 dw. to the ton, one of 160 tons gave 8 dw. to the ton, and one of 20 tons gave a return of 8 dw. to the ton. A cyanide plant was erected at a later date, but although the veins here have been prospected from time to time nothing payable appears to have been found. Apparently with a very cheap metallurgical process this group of veins could be worked at a profit.

vii. The Birthday Lode.

The lode under consideration is situated near Bartley's Creek, about 4 miles to the south-west of Parkes. In 1896 it was worked by a company, which erected a 10-head stamper battery. Prior to this date it had been worked for some years, but not extensively. The vein is wide, and occurs as large lenses of gold quartz, alternating with very narrow portions.

During the year 1897 the company now known as the Avoca Reefs Gold-mining Company crushed 495 tons stone for 179 oz. gold from the lode under consideration.

In the early part of 1899 the Avoca Reefs Company (late Birthday Company) applied for aid from the Government Prospecting Vote [P.B., 99-3,212] to further test the value of their property. In the application it was stated that the lode was well-defined, and averaged about 5 feet in width, and that the main shaft was down 288 feet, vertical for 160 feet, at which point the reef had been cut, being 5 feet wide at this point.

From this point, it was stated also, the lode had been followed down on the underlay for 240 feet, where it had disappeared into the hanging wall. At the bottom of the shaft a cross-course had been put into the hanging wall, where the lode had been again cut, being 4 feet wide at this point. At 120 feet down, 190 feet of driving had been done; at 140 feet, the drive was 60 feet; and at 200 feet, 450 feet in length. £10,500 had been expended as wages, and the machinery on the ground cost £3,300; fifty men being employed. The request was for aid to sink the main shaft a further depth of 150 feet, and to drive 200 feet. The aid was granted. In 1900 the shaft was down 436 feet, and aid was again granted to carry the shaft down a further 50 feet. This gave a depth of 486 feet for the shaft. The prospecting was of a disappointing nature, no payable stone being discovered. The shoot of gold-bearing stone was supposed to be from 60 feet to 100 feet distant from the shaft at the 487-foot level. No further prospecting of an important nature appears to have been done on the Avoca Reef since the year 1900, and the machinery has been removed.

viii. The Welcome Lode.

The original name of this vein was the "Wild Cat." It is situated about 2 miles south of Parkes, alongside the Forbes road. The prospectors were A. Knox, J. A. Davis, A. G. F. Bollinger, and W. H. Boazman. There is no outcrop to the vein, the quartz being buried beneath a thick capping of

alluvium. The strike of the lode is north-east, the underlay is one in seven, and the greatest depth attained is 300 feet. Two other shafts besides the main one have been sunk, one 95 feet, and the other 200 feet; both of these were connected with the main shaft. The length of the lode proved is 560 feet; it varied in width from 2 to 4 feet; the ore occurred in lenticular shoots; and water level is reported as being 230 feet deep.

In 1900, 1901, 1902, and 1903, about 1,800 tons of stone were treated for a return of 900 oz. of gold. Since 1904 mining operations have been practically abandoned along this line of lode.

ix. Minor Lodes of Parkes.

No access was had to the working of the mines enumerated in this chapter, with the exception of that worked by Glasheen and party in the vicinity of the township itself. The information supplied here has been obtained mainly from the Annual Reports of the Department of Mines; from the Mining Records obtained by the Inspectors of Mines; and from Prospecting Board and other papers in the possession of the Department of Mines.

The Homeward Bound Lode lies about nine miles north of Parkes, alongside the Peak Hill road. The vein, which is reported to be 18 inches in width, occurs in an area of slates and tuffs, associated with amygdaloidal and finely-grained andesites. Morrison and party were the prospectors. A shaft 200 feet deep was sunk on the lode, and 500 feet of driving was done. A five-head battery was erected at the mine, the total plant being valued at £800. . . . 185 tons of stone were treated in 1901 for a return of 85 oz. of gold.

In 1902 stone was crushed to the amount of 262 tons for a return of 111 oz. of gold.

McGregor's Lode.—The official records for 1883 show that one parcel of stone taken from this mine, and weighing 27 tons, yielded a return of 160 oz. of gold, while another parcel of 40 tons yielded 64 oz. of gold. Prior to 1883 this ground had been prospected by many parties, but abandoned.

The Currajong.—Information concerning this lode is meagre. In the earlier days of the field it yielded rich returns, but these had been followed by poor ones. In 1908, Mr. J. Channon obtained 219 oz. of gold from a parcel of 703 tons of stone. Machinery of the value of £200 was erected.

The 'Possum Lodes [Caledonia Hill, Lee and party, Glasheen's, Gladstone, &c.]—In the vicinity of the 'Possum Lead a belt of andesite occurs, intrusive into the slates and siliceous claystones. Throughout the length of this intrusive belt, and in the adjoining slates also, numerous gold veins occur. Many of the veins have no outcrop at the surface, being buried under about 50 feet of alluvium, and their presence has been revealed by alluvial mining operations. They are sometimes arranged along north and

south, and sometimes along east and west lines. The andesite is altered as much by the lode material as are the slates. In many instances, in fact, the lodes may be observed to be the result of country replacement in part, and a considerable development of pyrites has been induced in the andesites adjoining the lodes. Under the general heading of the 'Possum Lodes are included the less important lodes only, the more important ones, such as the Buchanan, the Phoenix, and the Bonnie Dundee, being described elsewhere.

1. *Caledonia Hill*.—In 1877 stone from this locality yielded returns as high as 2 oz. gold per ton.

2. *Lee and party's Lode* lies on the Forbes Road, at a distance of about half a mile from Parkes. It occurs in altered andesite country and is associated with calcite, iron and arsenical pyrites. Mr. Inspector Smith states that it is of the true fissure vein type, possessing a strike running north-east and south-west and an underlay to the south-east. The depth sunk on the lode is 105 feet, and the maximum length worked is 160 feet. There was no outcrop, the surface being formed of alluvium.

In 1902, a crushing of 100 tons of stone yielded 233 oz. of gold, and in 1903, the treatment of 70 tons of stone yielded 106 oz. of gold.

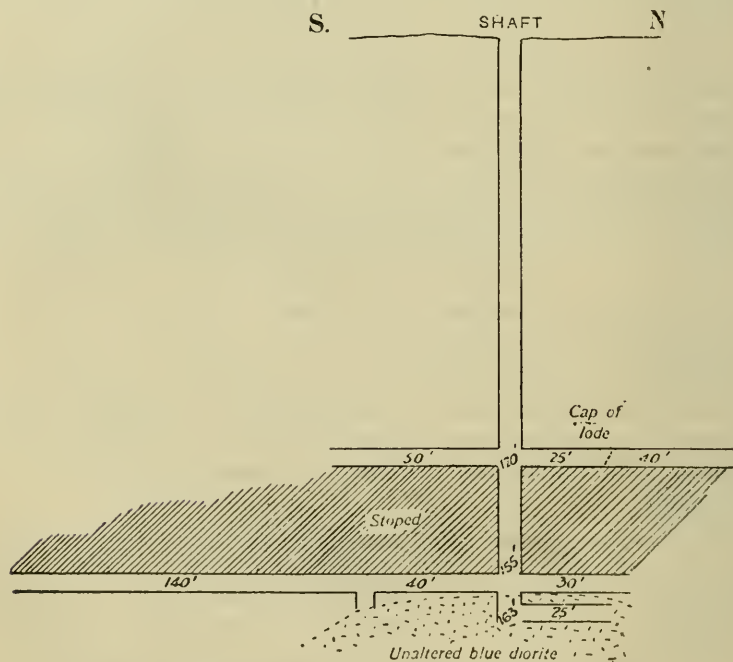


FIG. 14.—Longitudinal section of Lee and Stevens' Reef. (J. E. Carne).

3. *The Federal Lode* (Glasheen and party) adjoins that worked by Lee and party. It is a quartz vein in andesite near its junction with slates. The strike is north-east and south-west, the dip is south east, and the average width of the vein is from 10 to 15 inches. The length of lode opened up in 1909 was 60 feet, and the greatest depth reached was 220 feet.

In 1902, a crushing of 16 loads gave a return of 4 oz. 4 dwt. of gold per load. In 1903, a crushing of 70 tons yielded 106 oz. of gold, valued at £384. In 1905, the main shaft was sunk to a depth of 220 feet, and during the same year 94 tons of stone were crushed for 207½ oz. of gold, valued at £605. In 1908, work was confined mainly to prospecting. Up to the end of 1909, more than 1,100 oz. of gold have been obtained, and the average yield of the stone appears to have been about 1½ oz. of gold to the ton over the battery plates. In addition to this, cyaniding of the sands yielded returns varying in value from 3 to 6 dwt. of gold per ton.

4. *Gladstone Lode*.—Very little information concerning this lode is to be found in the official records. In the year 1890, however, two companies appear to have been working it, one of which was the Gladstone Gold-mining Company, with a capital of £10,000.

During the year 1890, the main shaft of the Gladstone Gold-mining Company was sunk from the 145 to the 195-foot level. A stope, 25 feet width, was here worked, from which 100 tons of stone were obtained, yielding 248 oz. of gold. From the 195-foot level, drives were run north and south of the shaft for a total distance of 162 feet, this work exposing a lode averaging about 2 feet in width.

In 1900, an application was made to the Prospecting Board for aid [P.B. Papers, 00-12,427] to test the lodes under the 'Possum Flat, from the 125-foot level in the Gladstone shaft. In all, 420 feet of driving were accomplished, but nothing of importance appears to have been disclosed by this prospecting campaign.

Mount Morgan.—The gold values of the mine of this name lie in a zone of crushed andesites. Quartz is present. In 1905 two shafts were sunk, each about 35 feet in depth, both being connected below the surface. Twenty-eight tons of stone were crushed for a return of 39 oz. of gold.

Nibbler's Hill.—A considerable amount of prospecting has been carried on in this locality. The hill is composed of silky and schistose slates, intruded by andesites. Near the junction of the two types of country a number of quartz veins occur. Splendid results were obtained from the surface stone, but after prospecting to depths exceeding 100 feet, the miners abandoned the spot. Several shallow "leads" take their origin in these gold veins.

The Old Welcome Lode.—Very little reliable information exists as to the working of this lode. It was one of the first which was worked in the Billabong (Parkes) Field during the year 1862. It occurs in a belt of andesite possessing flow structure. The stone in the oxidised zone was reported to have been very rich. Mr. Tanser is at present prospecting one of the veins.

Ben Nevis Reef.—The following notes have been copied from a report made by Mr. J. E. Carne, Assistant Government Geologist (94-2021).—"In the year 1894 the Ben Nevis Lode was worked by S. Woodward and party.

The lode, which occurs about a quarter of a mile to the north of the eastern end of the Ben Nevis Lead, is in slate country; its strike is about north-east and south-west, with a westerly underlay. Four shafts, in 1904, had been sunk on the lode within a distance of 50 yards, and payable stone had been worked to the 100-foot level. The last crushing, in 1874, was said to have yielded $1\frac{1}{2}$ oz. of gold a ton. The payable stone, however, was soon lost. The work done in 1894 consisted of a shaft sunk to a depth of 130 feet, and drives put in thence 24 feet east and 29 feet west. No good result appears to have resulted from this work."

The New Haven Lode lies about two miles from Parkes in a westerly direction, on a continuation of the belt of auriferous country in which the London Lode occurs. Mr. E. C. Whittell, Mining Inspector, reported as follows on this lode (Papers P.B., 99-1041).—"On the hanging wall side the country is impregnated with countless quartz veins and this material, together with the quartz reef, has been crushed. Its width is 8 feet at the surface, and 28 feet, as far as proven, at the bottom of the slope. It contains only 3 to 4 dwt. of gold per ton."

The accompanying figure is a copy of that supplied by Mr. Whittell in his report.—"A, shaft down 76 feet on the underlay—50 feet from B (see figures). B to C, slope 68 feet long, open to surface—about 55 feet deep. D, shaft 55 feet deep.

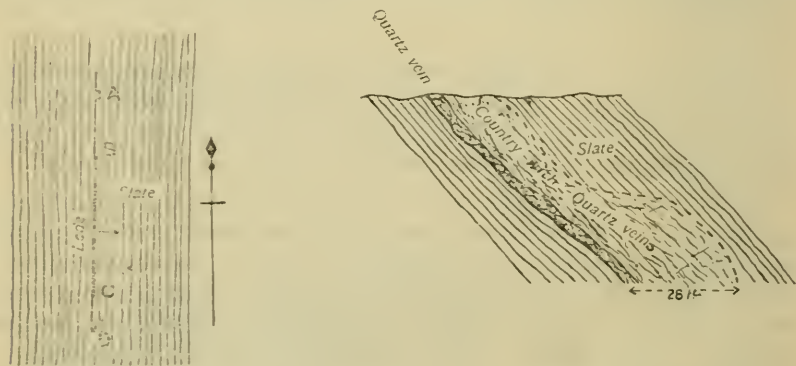


FIG. 15.—The New Haven Lode, Parkes.—A, shaft; depth, 76 feet on the underlay; 50 feet from B. B to C, slope 68 feet long, open to surface; about 55 feet deep. D, shaft, depth 55 feet.

The Mount Pleasant Mine is situated within the town of Parkes.

In 1897 two shafts had been sunk on the lode to depths of 150 and 210 feet respectively. In 1899 these had been carried down to depths of 184 ft. 6 in. respectively. Aid was granted from the Prospecting Vote to sink a winze to a depth of 232 feet from the 182-foot level.

Staples' Lode is situated between M'Guiggan's Lead and the Blue Reef. Mr. J. E. Carne reported as follows on this lode in 1891 (P.B., 91-1730) :— "The reef strikes N. 20 W. and S. 20 E., and varies from 3 to 12 inches in thickness, with an easterly underlay. Three shafts have been sunk on the underlay side of reef at distances of about 40 feet apart, and to depths of 40 feet, 60 feet, and 75 feet. Drives at the 40-foot and 60-foot levels have been put in. About 45 tons of stone raised are stated to have yielded from 13 dwt. to 1 oz. of gold per ton. The country rock is a micaceous slate, and picking ground to the lowest level attained." Aid was recommended to sink the main shaft from 60 feet to 100 feet, and to drive 32 feet north and 18 feet south on the reef from the 100-foot level. This work was carried out. The results obtained were satisfactory."

The accompanying sketch is from measurements taken by Mr. Carne.

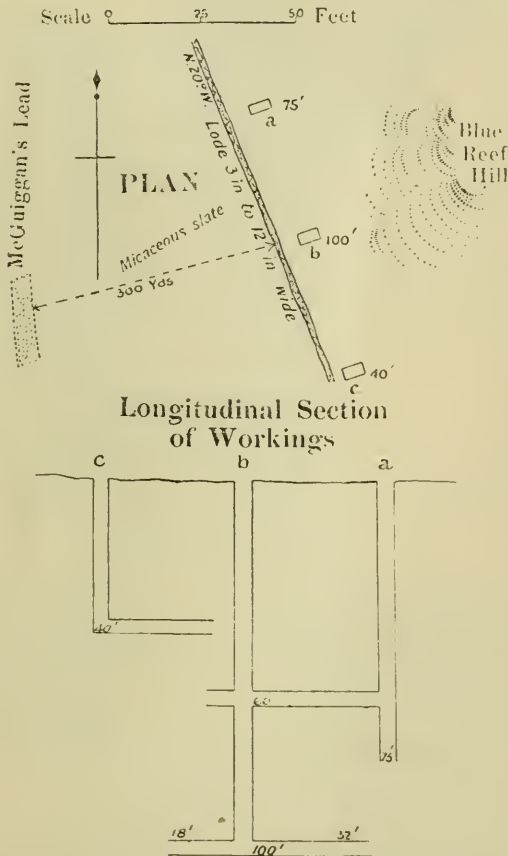


FIG. 16.
Plan and Section of Staples' Lode.

McMurray and Party's Lode.

Mr. J. E. Carne reported as follows on this property in 1891 (P.B., 91-3147):—"The reef strikes north and south with an easterly underlay. It was first struck at a depth of 60 feet in a shaft about 20 feet south of present shaft; in the latter it was struck at 90 feet, showing a steep dip to the north. The country rock is slate, which is compact and hard at the level mentioned. The reef occurs very irregularly, in some places only a few inches in thickness, in another bulging to 3 feet. Applicants propose to sink present shaft to the 150-foot level, then to drive along course of reef 60 feet north and 40 feet south. . . . 15 tons of stone taken from this reef in adjoining shafts are stated to have yielded 20 oz. of gold."

The proposed sinking and part of the proposed driving were carried out.

The accompanying figure, taken from Mr. Carne's measurements, illustrates the method of working.

Old Ramsay's Lode.—(Extracts from Report of J. E. Carne—P.E., 91-1613):—

"The occurrence is about $2\frac{1}{2}$ miles south of Parkes, in Gold Leases 98 and 99, Parish Parkes. The country is composed of contorted, cherty claystones, apparently of pre-Silurian age. The strike of the lode is about north-west and south-east, and its underlay is westerly. At the close of the year 1894 a shaft had been sunk 154 feet on the underlay. At this depth the lode varied from 14 to 20 inches in width, and yielded 7 dwt. of gold a ton at various points. One parcel of 47 tons from the lower 64 feet yielded 29 oz. 15 dwt. of gold. At a short distance from the main shaft another lode was found having a north and south strike, and a thickness of from 12 to 14 inches. The proposal, in 1891, was to sink to 250 feet on the underlay, to drive and to cross-cut at the 250-foot level for 100 feet.

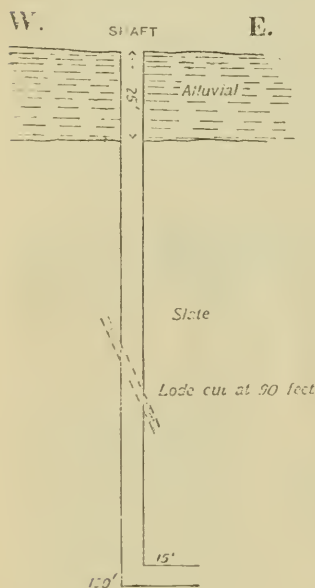


Fig. 17.

The shaft was sunk to 250 feet and a drive put in thence for a distance of 102 feet, to the south-east; the width of the lode at the bottom was 18 inches; 82 tons were crushed for 14 oz. of gold. Attempts were made also to ascertain the values of the parallel quartz masses by cross-cutting.

Baden-Powell Lode is of quartz, and occurs near the junction of andesite and tuffaceous slate countries, about $1\frac{1}{2}$ miles south of Parkes, along the Forbes Road. The vein is about 1 foot in width.

In 1901 about 241 tons of stone were crushed for 307 oz. of gold, and in 1902, 260 tons were treated for 780 oz. of gold, of the value of £3,000. About £6,000 worth of gold had been taken from this mine up to the end of 1902.

Barnett's Lode has not been of much value; it has been fairly well prospected. In 1890, a parcel of 16 tons gave a return of 170 oz. of gold. In 1891 it was abandoned.

The Pioneer Lode was discovered by James Pugh, in October, 1862, and here the first payable gold in the Parkes district was found.

The accompanying figure illustrates the workings as far as can be ascertained, and they are taken from a report by Mr. J. E. Carne in 1894.

The following is an extract from Mr. Carne's report (P.B., 94-2274):—
"It comprises the old Pioneer Reef, near the Dayspring Reef. Applicants have cleaned out the original whip shaft at the eastern end of the old workings. This shaft is 123 feet deep (60 feet vertical and 65 feet on the underlay). At the bottom only very thin leaders are visible in the shaft; a large bunch of quartz, however, makes in a short drive a few feet to the west. Alongside the bunch a winze 6 feet deep was sunk, and 60 tons of the stone raised yielded 5 dwt. of gold per ton. On the surface, about 100 feet southerly from the shaft, a large "blow" of quartz occurs, and a small reef apparently crops out about 50 feet northerly from the same shaft."

The Scrub Lode and the Associated Lodes. — The Scrub, McGuiggan's, and Blue Reef's are situated along a belt of country composed of schistose slates, associated with fissile andesites. The McGuiggan's, the Well Tried, and other "leads" rise in this area.

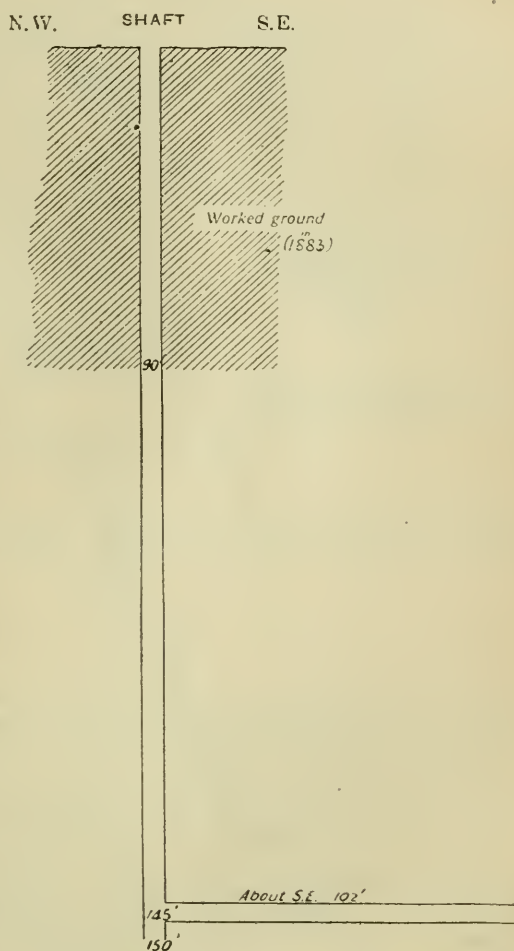


FIG. 18.—Old Ramsay Reef, M.T., 153, Parish Parkes (J. E. Carne).

Aid was granted to Spicer and company, in 1901, to continue the main shaft on the Scrub Reef to a farther depth of 72 feet, the depth at the time of the request for aid being 132 feet. At 132 feet the vein was thin and pinched, but well-defined.

The shaft was carried down to a depth of 155 feet. The vein in the bottom was very narrow, and then work was discontinued. From the shaft between the depths of 132 and 155 feet the prospectors crushed 12 tons of stone for an average yield of $8\frac{1}{2}$ dwt. of gold a ton.

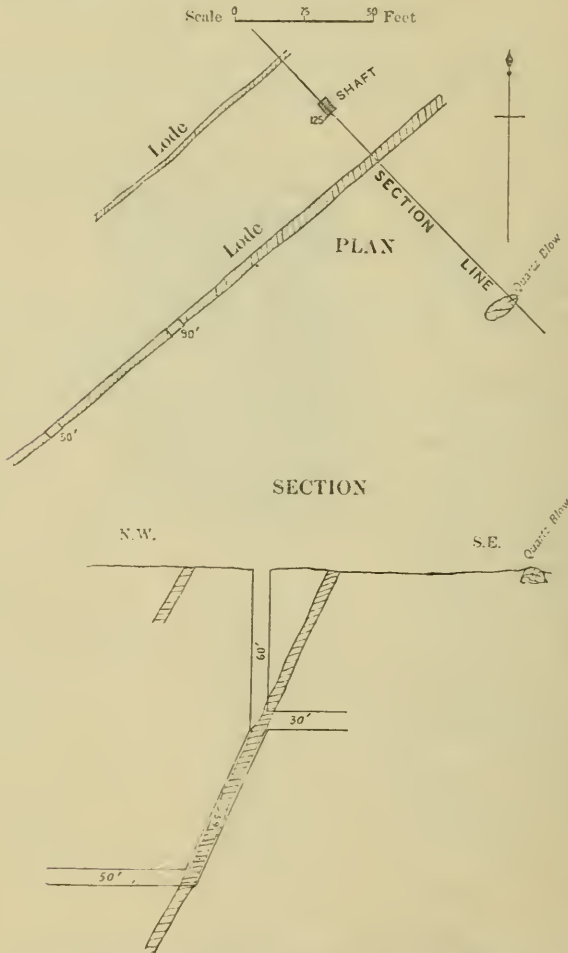


FIG. 19.—Plan and Section of Pioneer Workings (J. E. Carne).

Burgess and Smith's Mine (Reid's Gully).—The Reid's Gully Lodes occur here. They occur mostly as networks of small quartz veins arranged in a north and south direction, and in an area of schistose slates and tuffs. In 1896 it was reported that the "formation was about 40 feet wide, which yields 8 dwt. per load all through." [Ann. Rept. Dept. Mines N. S. Wales for 1896, p. 28.] In 1897, Burgess and Smith erected a 5-head stamper battery. During this year they decided only to follow the small veins through the andesite and slate formation. Occasionally, these were found to be very rich, but their average width could not have exceeded 1 inch.

These veins and veinlets occur along a line of andesite lavas and tuffs. The andesites in places possess a vertical cleavage and have the appearance of highly-cleaved slates. Careful prospecting has been conducted along this line for a considerable distance. The Mount Morgan quartz veins also lie along this line.

- *Fitzgerald's Lode*.—A shaft 130 feet in depth is said to have been sunk in 1889 on this line. The lode itself is 4 feet in width. 110 oz. of gold were obtained from 65 tons of stone during the year 1889.

The Lady Jersey Lode occurs beneath the alluvium of the Tichborne Lead. The occurrence is a strong quartz vein in andesite. The following description and accompanying figure have been taken from the field notes of Mr. J. E. Carne, during the year 1891:—The shoot of gold dips to the east. One parcel of 15 tons was crushed for 3 oz. a ton; 148 oz. gold obtained from 148 lb. weight of stone, and 15 tons yielded 3 oz per ton. The reef is made up of four veins, which make below into one. The veins are at a distance of 1 inch only from each other. The lowest level is in solid diorite. "Over the diorite country was rich alluvial. Proposed to sink present shaft to 150 feet and then to drive along it east for 100 feet."

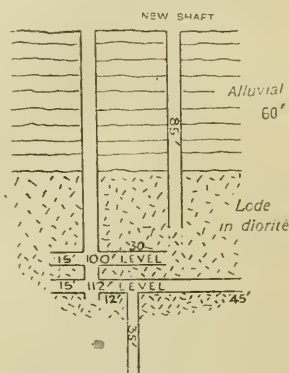


FIG. 20.—Section along Lady Jersey Lode, Tichborne (J. E. Carne).

CONCLUSIONS, as to the probable future of the mining industry at Forbes and Parkes.

A.—FORBES.

1.—Leads.

(a) From the descriptions of the South and the Caledonian Leads in the main report, it will be noted that they became less payable as they were traced downstream, beyond the limits of the auriferous belt. The gutters increased in width with progress downstream; the wash-dirt increased in volume, and the gold became much more sparingly distributed through the drift, partly because of the enlarged cross-section of the gutter, partly because of the increasing fineness of texture of the wash-dirt, and partly because of increasing distance from the auriferous belt. The claims on the South Lead were payable as far downstream as the present Lachlan River, but at a short distance to the south of the river, the alluvial gold was found to be of too scattered a nature to pay for its extraction.

A similar condition of things appears to have been found while following the Caledonian below the Rifle Butts.

As for the channel of the old buried Lachlan River itself, one can only conclude that the probability of finding payable alluvial deposits there is very remote, for in the first place, its catchment area is enormous as compared

with the area of the auriferous belt drained by it; and, in the second place, the texture of its channel deposits were doubtless of too fine a nature in which to expect valuable alluvial deposits of gold.

These facts thus indicate that any exploitation of the downstream portions of the South and Caledonian Leads cannot be successful unless cheaper mining methods be introduced than were in existence during the period 1880-1900.

It is highly probable, however, that the Britannia lode continues to the south of the point where it passes under the Lachlan alluvium, and that it shed gold into the old main drainage line to the south of the Madman's, Grassatt's, and Britannia Leads. If this old buried main channel crosses the southern continuation of the Britannia lode, it will doubtless be enriched at points immediately down stream of the lode. The Britannia Lead is also deserving of attention along its upstream portion.

(b) The deep channel, about a mile and a half to the north-west of the town, was supposed by Mr. Wilkinson to be connected with the "Red Streak," a deposit of river wash about 200 feet below the surface, and lying about half a mile to the west of the town along the northern Condobolin road. No connection has ever been established between the two, probably because the mining community appear to have been misled by the appearance of the surface. Bores were put down across two small valley depressions leading from the deep shaft on the north to the "Red Streak" on the south, while the higher land between the shallow depressions was left alone, because it was supposed to be composed of rock. The whole, however, is a wide sheet of alluvium, in which side streams cut shallow depressions at the time the Lachlan entrenched itself from 25 to 40 feet deeper than formerly into the alluvial plain. This more elevated alluvium should have been bored as well as that beneath the shallow depressions.

The channel, however, in all probability, drained the non-auriferous Silurian rocks situated immediately to the west of the auriferous belt. At the same time the drainage of the auriferous belt itself appears to have gone towards the South and Caledonian Leads.

The geographical conditions therefore do not appear to have favoured the introduction of gold into this, the deepest of the Forbes Leads.

(c)—*The Thompson and Bald Hill Leads.*—Between the farthest point, worked downstream along the Thompson Lead and the nearest point thereto worked along the Bald Hill Leads, there appears to be a considerable area of deep and untried ground. This ground is bounded immediately to the west by the long line of the important Lachlan Lode. Whilst at Forbes I could get no certain information about this ground, nor could I ascertain whether this ground had been tested by boring. In the event of no boring tests having been undertaken, I would suggest that the area is well worthy of such a test, the plan of a proposed line of bores being indicated on the accompanying sketch of the vicinity.

2. Lodes.

Both the Lachlan and Britannia lines of lode appear to be worthy of further development. Replacement of country with the production of large lenses of pyritic ore has taken place along this line of lode.

B — PARKES.

1. *Leads.*

(a) The No Mistake, the London, the M'Guiggan, the Ben Nevis, the Great Northern, and the Welcome Leads were all abandoned as unpayable after being traced for variable distances downstream beyond the auriferous belt. Their gutters became flatter; with the increasing flatness of the gutters the wash-dirt became more voluminous and more sandy in nature, and the gold values contained therein decreased proportionately to the increasing bulk and to the increasingly fine texture of the wash-dirt. It is thus probable that the lower portions of these gutters will not pay the expenses necessary to work them under present conditions.

(b) It is probable that the old buried Billabong Creek at Parkes does not contain a large body of payable alluvial gold. The evidence upon which this conclusion is based is similar to that brought forward in the case of the old main drainage channel of the Forbes area.

(c) Bores or shafts sunk across the plain near Tichborne—both along and across the strike of the auriferous belt—may yet disclose the existence there of a payable deep lead.

2. *Lodes.*

From an examination of the literature dealing with the Parkes Gold-field, it would appear that the Phoenix, Koh-i-noor, Bushman, and Dayspring Lodes have not yet been proved to be "worked out," and it is still probable that payable shoots of ore may be found in these mines. The Birthday Lode may also be classed with those just mentioned, although it appears to be a little to the east of the auriferous belt proper.

Much of the auriferous belt is at present covered by alluvium, and payable reefs may be found in the future as the result of intelligent prospecting for alluvial gold deposits underneath the plain.

GEOLOGICAL MAP OF THE FORBES—PARKES GOLD FIELD

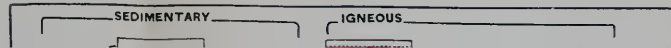
Geologically Surveyed by E. C. ANDREWS, B.A., Geological Surveyor, assisted by C. E. MURTON, Field Assistant.

Prepared under the direction of E. F. PITTMAN, A.R.S.M., Under Secretary for Mines and Government Geologist.

Department of Mines N.S.W. 1910.

Scale 0 40 80 120 160 200 240 Chains

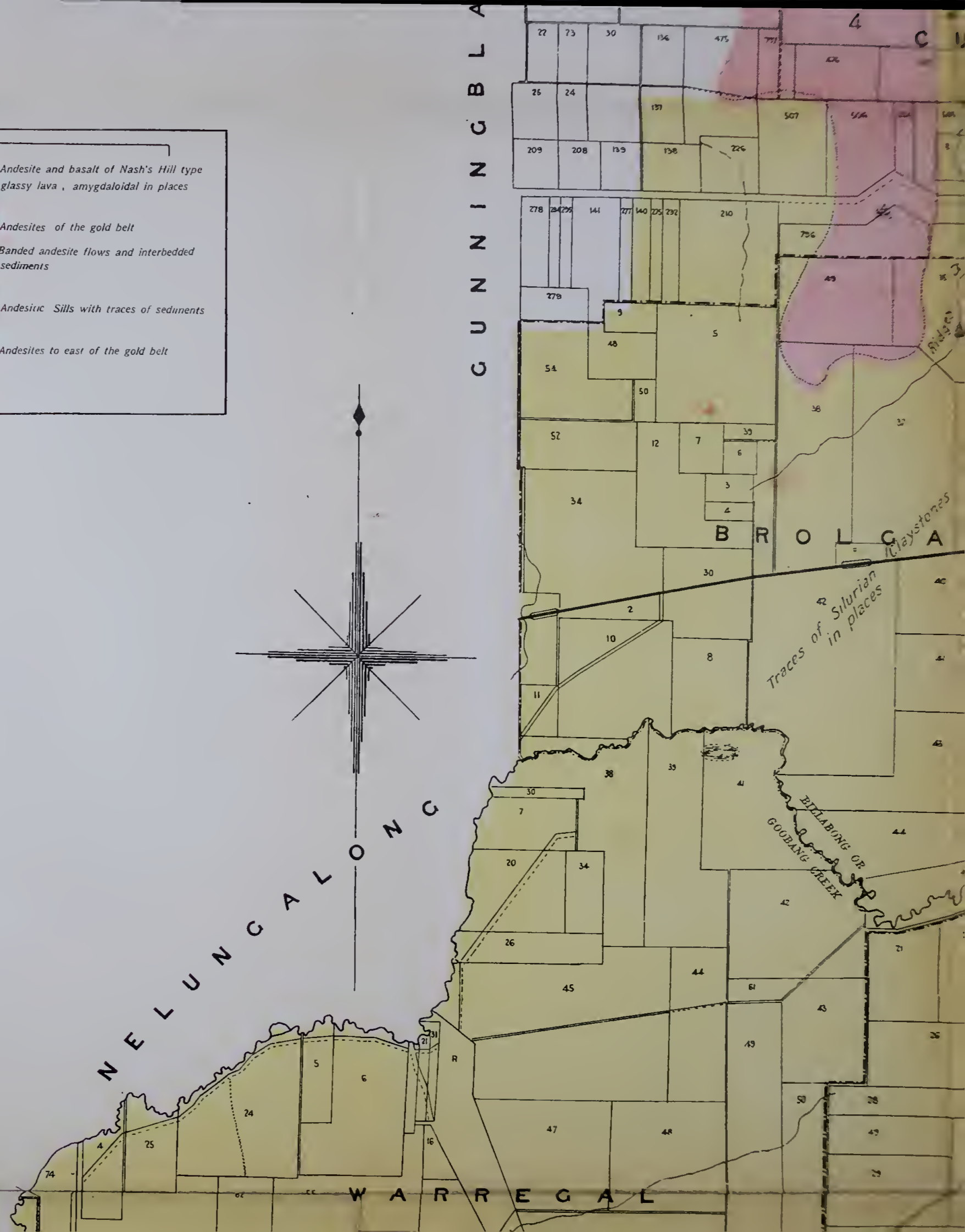
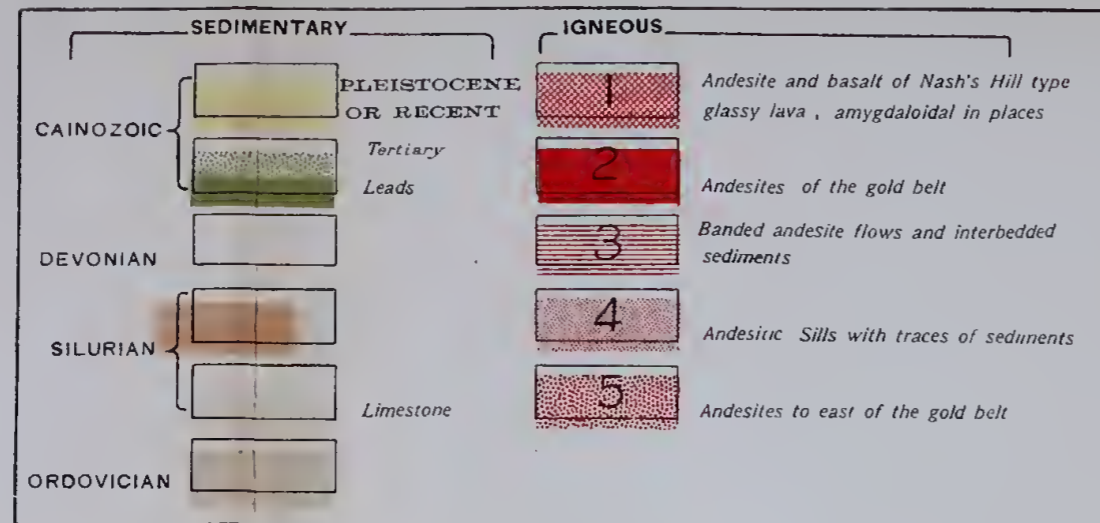
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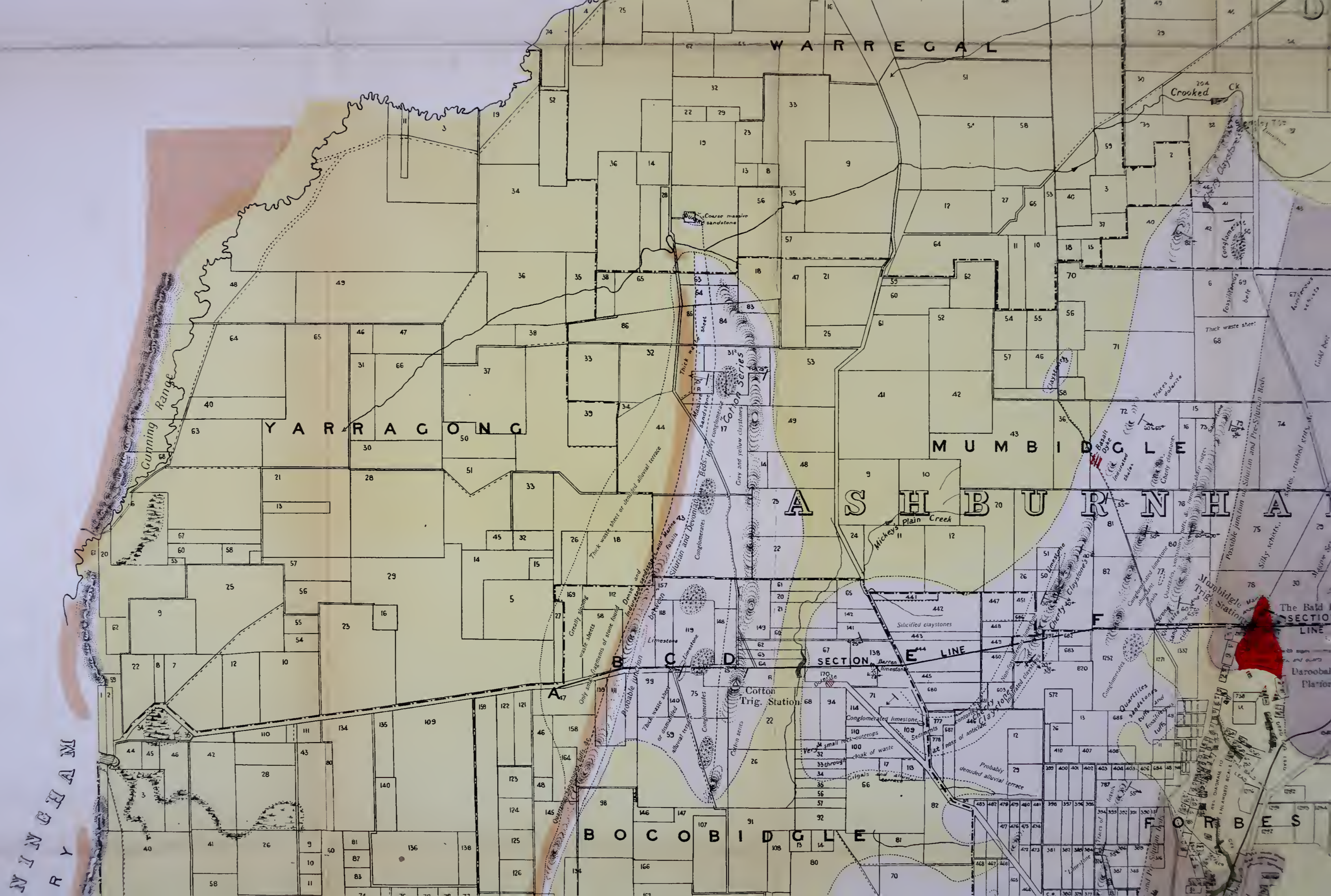
STONE

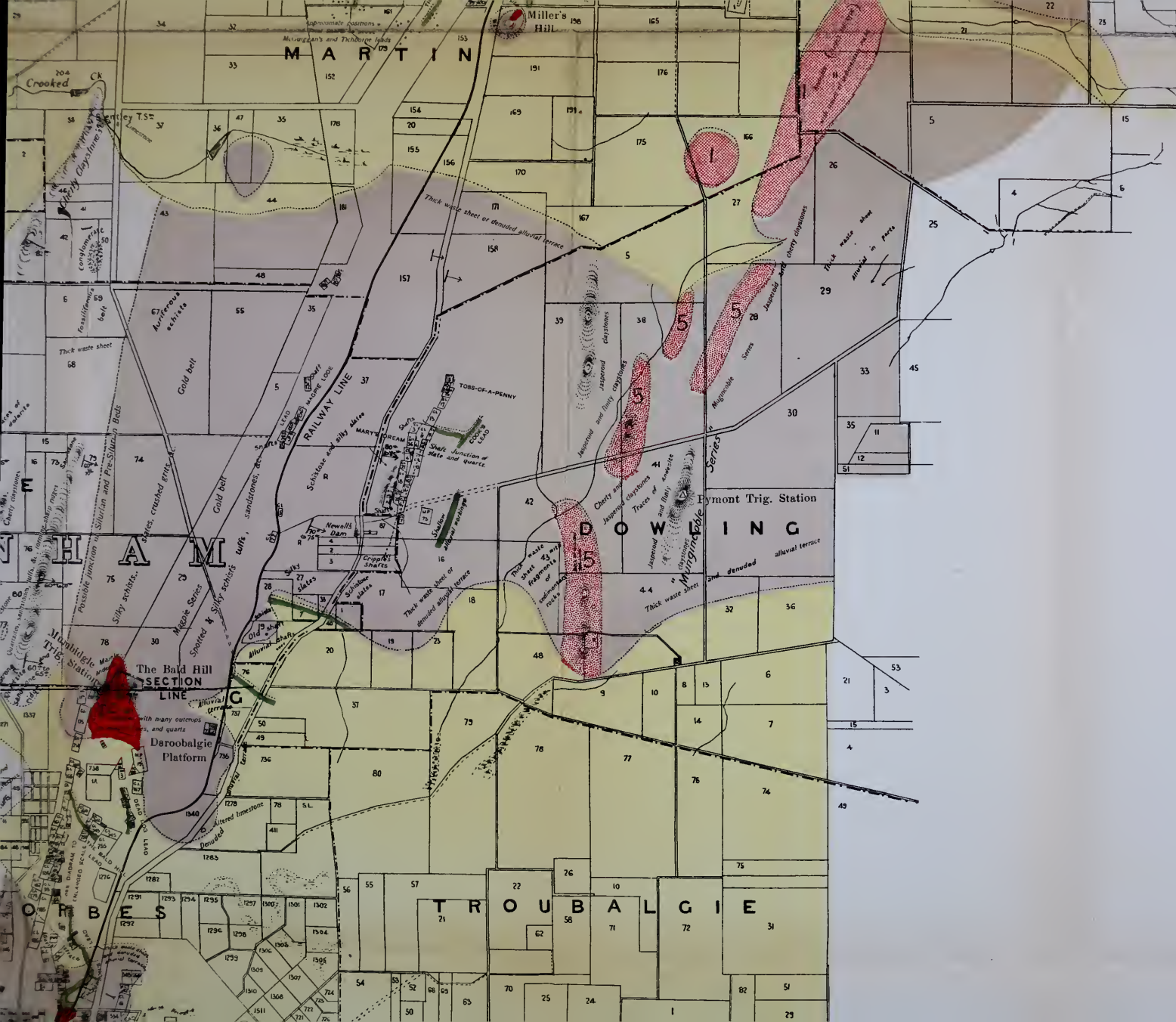


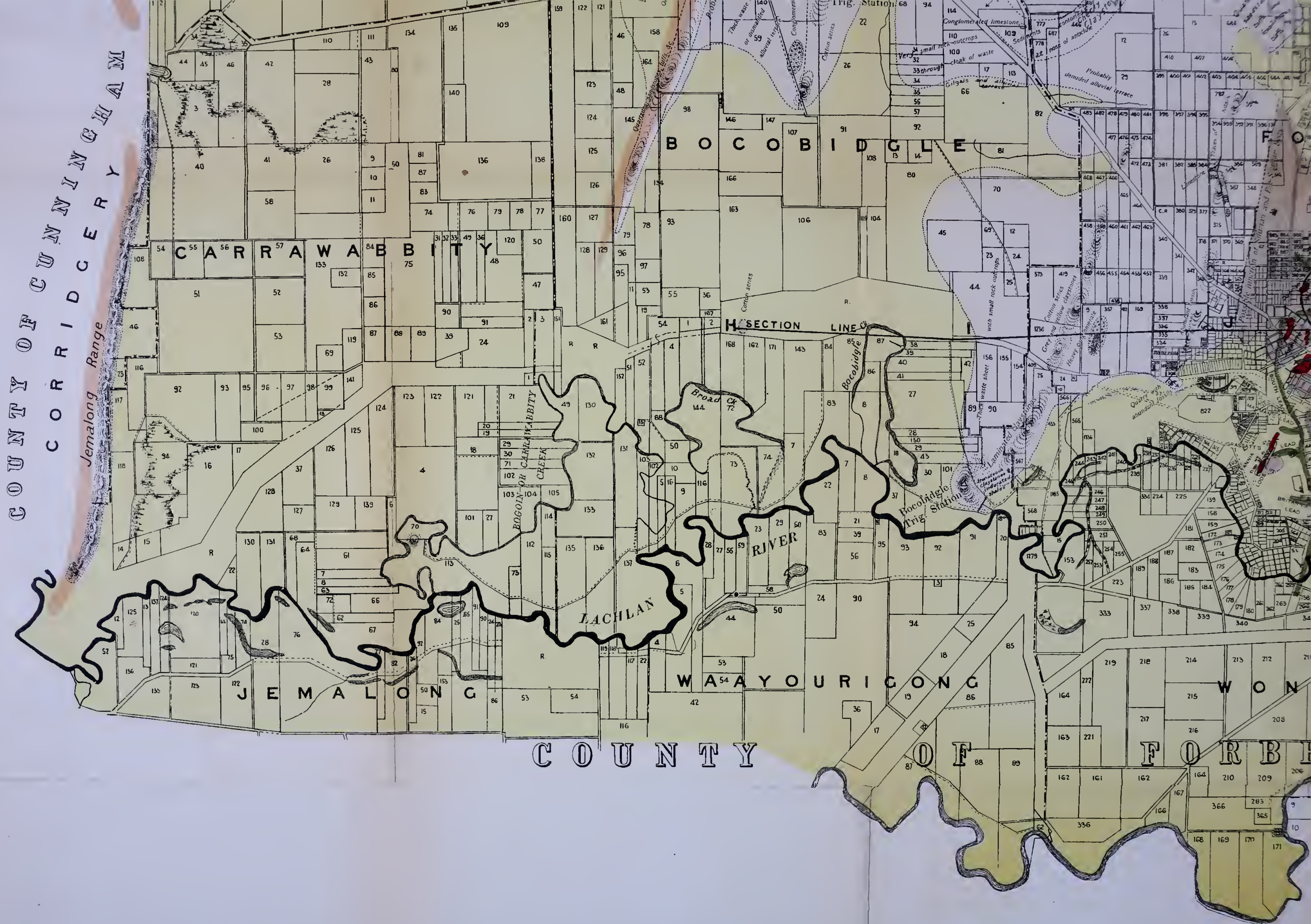
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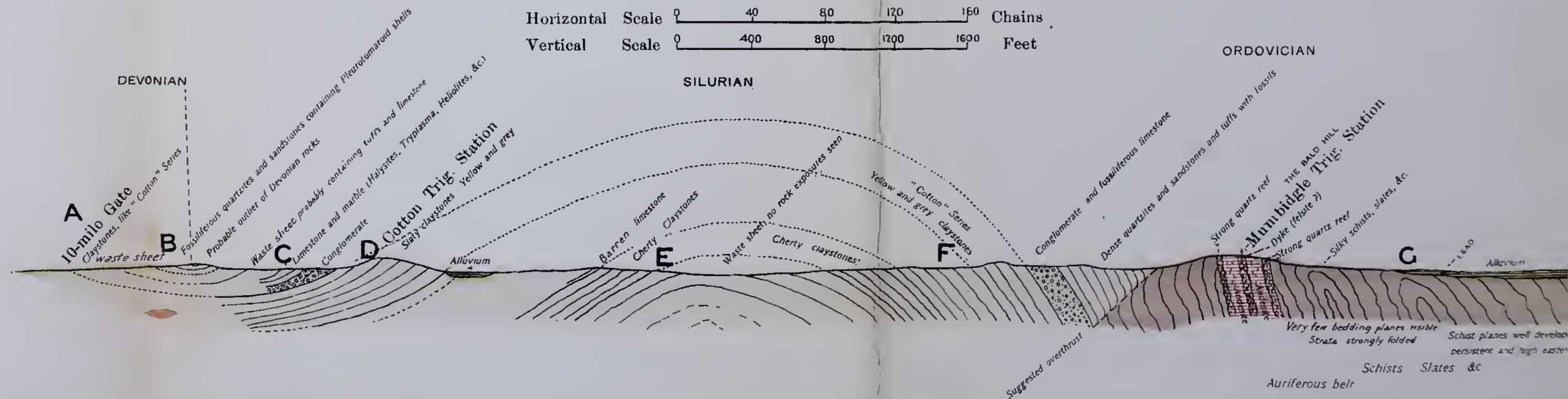
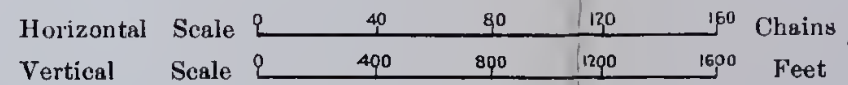








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